Editorial

THE tape recorder is about to become a number one electronic aid.

Most people now recognise the machines on sale in radio shops featuring a pair of reels, a box of tricks and a length of the magical brown ribbon. They know what fun may be had recording each other's voices; they know too, that more elaborate machines are now used almost exclusively for making the originals of phonograph recordings, and that many popular radio shows are rebroadcast from tapes.

But the tape recorder hasn't stopped at that. If it reached a dead end as a substitute for the phonograph record itself, it has now ventured so far into fields beyond the scope of the disc that sound recording as such can be regarded as little more than hack work.

The tape's primary job is to register and retain a succession of electrical impulses fed to the recording head from some source. A microphone is only one such source. If we attach electrical generators to the controls of a machine, so that their movements cause signals to be impressed on the tape we can reverse the process by playing back the tape so that it actuates the controls of a second machine, thus making it duplicate exactly the work of the first one.

This is only one example of how tapes can be used in industry. But there is another and even more important field opening up.

Engineers have succeeded recently in recording a bandwidth of up to 3-million cycles per second—wide enough to record the electrical impulses representing a television signal. This means that a television programme can be made as a direct recording on tape, and played back just as easily, without the numerous processes required for film. It is true that at present very high tape speeds are needed—up to 30ft per second—but this will be bettered in time. As it is, RCA in America have recorded on a half-inch tape a complete color television programme. This tape carries five tracks—three for color, one for synchronising and one for sound.

It doesn't take much imagination to realise what developments such as these will mean to the production and distribution of television programmes.

Some practical method of pooling the world's resources of television material has been required for a long time. Such a promise is perhaps the most spectacular aspect of the brilliant future which lies ahead of a million miles of tape.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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Vol. 15 No. 12

SUBSCRIPTION RATES
C'wealth, NZ, N. Guinea, Fiji—18/- pa
United Kingdom—£1/-/6 pa
B. Empire—£1/3/- pa
Foreign—£1/5/- pa

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Reveals

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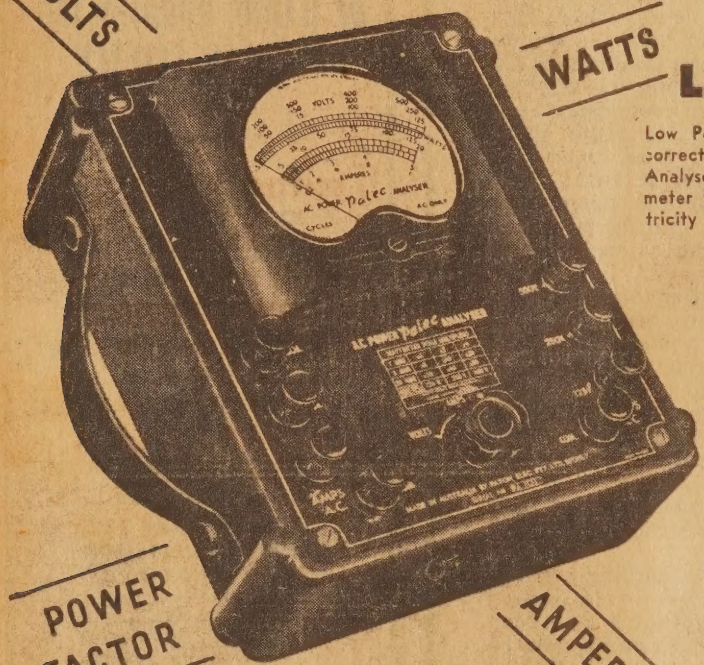

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Current D.C. 0/1-3-10-30-100-300-1000 mA.	7
Current A.C 0/1 mA (for use with ext. current transformers)	1
Ohms 0/1000: 0/10000: 0/1 megohms	3
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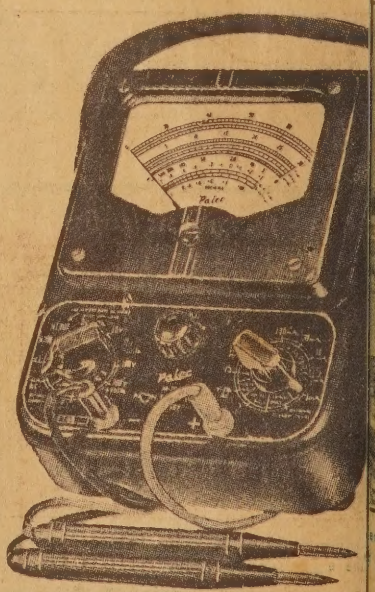

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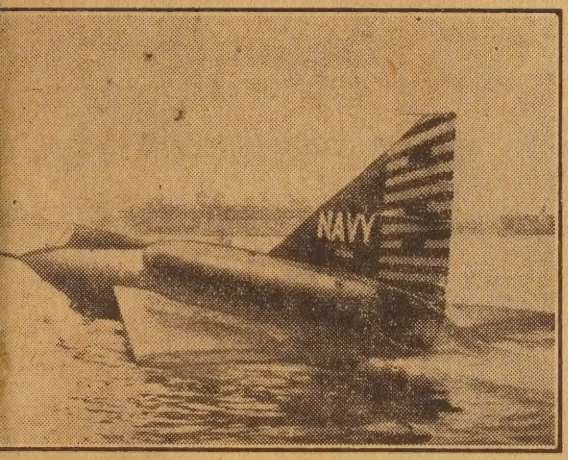
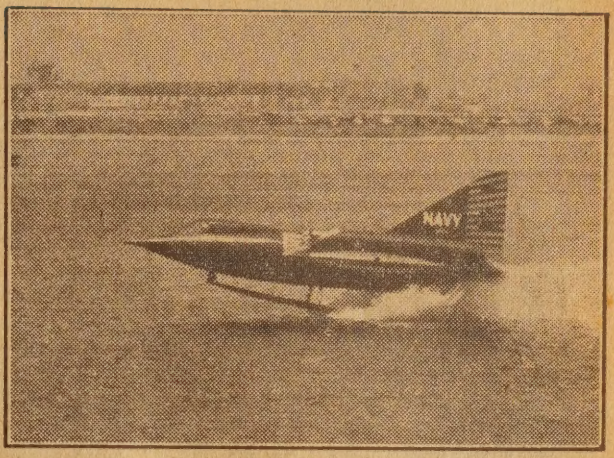
PICTURE STORY OF "SEA-DART"

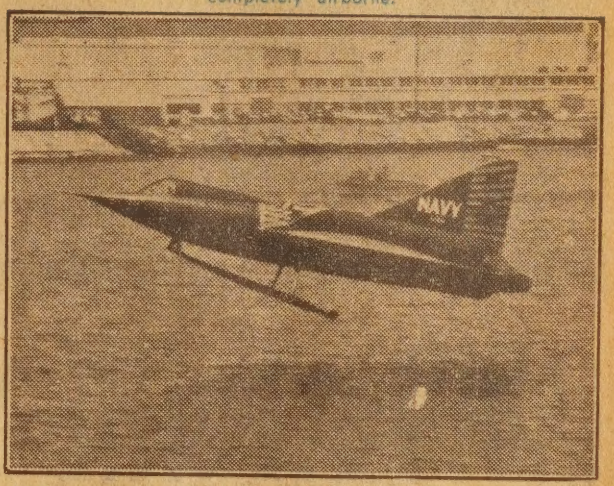


laimed to be the world's first delta-winged twin-jet seaplane, he "Sea Dart" taxies on San Diego Bay, ready for a demonstration flight.

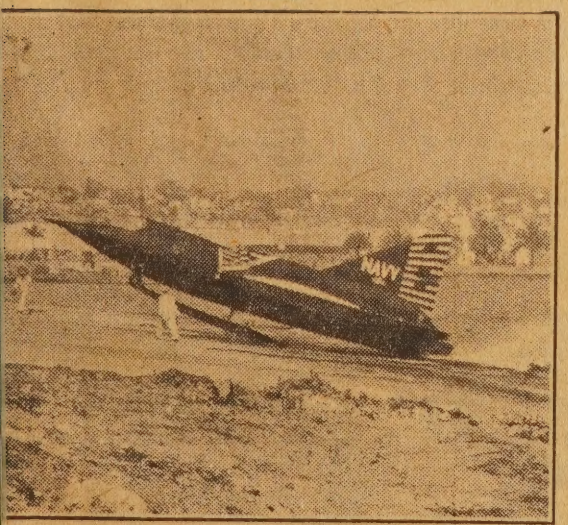


Jets thundering, the "Sea-Dart" rises on its hydro-skis, lifting the fuselage clear of the water. In a few moments it will be completely airborne.

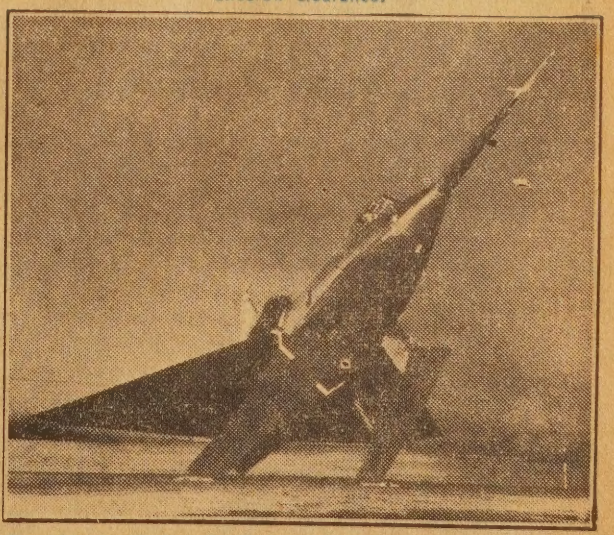
flight hydro-skis retract, leaving the plane with the lines of a issile. The XF2Y-1 "Sea-Dart" is a product of Consolidated Vultee.



Flight over, the XF2Y-1 comes in for a landing. The design is possible because the jet motors eliminate the usual need for airscrew clearance.



cial feature of the plane is that it can enter or emerge from water under its own power and without any assistance from beaching gear.



The "Sea-Dart" doesn't mind rough water. Note how skis assemble ordinary water-skis, giving stepped-hull effect to fuselage when extended.

Michael Batten, news reporter on the staff of the Sydney Sun, uses one of the pack sets designed by John Moyle and constructed in the Radio & Hobbies laboratory. Operating from a miniature 6-volt accumulator, the equipment uses 9 valves, amplitude modulation and operates in the 70Mc. band.

RADIO AT THE ROYAL LANDING

Her Majesty Queen Elizabeth II, the first reigning monarch to visit Australia, made history on February 3 as she stepped ashore in the bright sunshine of Sydney's Farm Cove. But the event was historical in another sense, for it was covered and organised by the largest concentration of radio equipment ever used in the Commonwealth.

by Neville Williams

RADIO controlled the movement of ships, of planes and of public transport. Radio carried a description of the landing and procession into countless homes and overseas, and to the million people lining the route. Radio carried news stories and pictures to the nation's newspapers.

And, for the first time in Australia, radio waves carried a television report—intimate closeups of the ceremony—to groups of sick and crippled children gathered around television receivers.

Throughout the ensuing days, wherever the Royal couple went, radio followed them. Police and transport cars controlled crowds, opened and closed streets, re-directed trams and buses. Newspaper walkie-talkies and radio cars followed their movements. Microphones caught their words to feed recorders, broadcast networks and newsreel cameras.

That much was obvious enough to the man in the street, but, behind the scenes it represented the culmination of months — even years—of work by technical personnel. Even the staff of Radio and Hobbies had played their part, mixing the publication of this magazine with the production of the entire mobile radio system used by the Sydney Sun.

Actually, coverage of the Royal visit began while the Royal party was still hundreds of miles from our shores.

When ships of the RAN approached the Gothic 650 miles from our shores and took over from the New Zealand escort, newspaper cameramen recorded the event, then dived below to develop and print their pictures.

Soon afterwards, the prints were being wound around the drum of a picture transmitter, specially installed on the aircraft-carrier Vengeance, scanned by a beam of light and converted into electrical impulses.

PICTURES BY RADIO

Picked up in Sydney, the clicking, warbling tone was piped through to various newspaper offices and turned back again into pictures. You saw them in the paper a few hours later, while the ships still ploughed their way through the Tasman, hundreds of miles away.

The morning of February 3 saw the whole of Sydney astir very early —but not as early as the newspaper staffs, who, in a few hours, would have to flood the streets with papers carrying pictures and stories of events that were still in progress!

Only radio could provide the necessary reliability and speed and the news-gathering system as used by the Sydney Sun showed how valuable such a method is when telephones are jammed and isolated by crowds.

Altogether, six radio cars and four pack sets were in use, working back to a high-powered control station on top of The Sun building. There two trained operators stood by to handle the flood of stories and messages.

NEWS BY RADIO

As the pilot steamer Captain Cook hove to alongside the Gothic off the coast, a Sun reporter with a pack set radioed his story of the early morning meeting direct to the office in Sydney 10 miles away.

During the journey back to the Heads, his description of the scene flowed from the typwriters of the

copy-takers in Sydney. In the Harbor, three more reporters in fast launches were waiting to take up the story, each with a pack set. Events became news almost while they happened.

As the Gothic dropped anchor, she was immediately surrounded by a swarm of tiny craft. In one of them a Sun reporter had just begun to recount the scene when his voice was interrupted by a series of bumps and shouts.

"There's going to be tragedy here if they're not careful!"

As the Gothic swung at anchor, harbor craft completely blocked access to the ship's side. A patrol boat had nosed forcibly among them, to clear a pathway for the Royal barge.

A moment later, the reporter, less agitated, resumed his story. The critical moment had passed — safely, as it happened — but it had been a near thing!

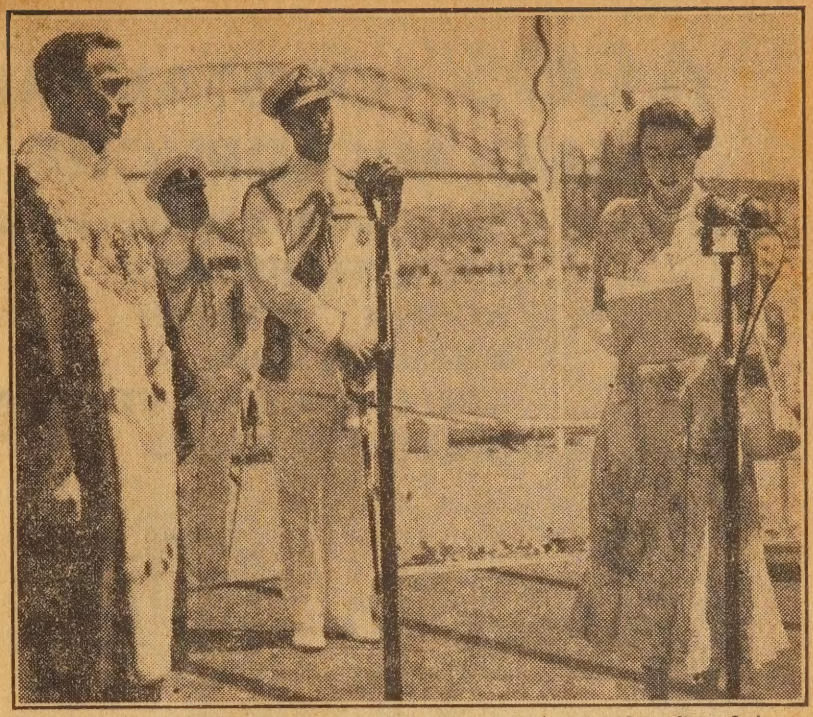
As the copy-taker typed his reassuring message, the reporter's warning had already hurtled down the pneumatic chute to the sub-editor's desk — "news" within seconds.

CO-ORDINATION

At one stage, a group of photographers with urgent pictures found their route back to the office blocked by crowds and traffic. Sensing their difficulty, a reporter in a launch made a rendezvous by radio and took them to another point on the foreshores.

There a second radio car picked them up and rushed them back to the office to catch the next edition.

So it went on throughout the morning. While a Sun car in the procession radioed back the crowd's reactions along the route, other cars and pack sets were being sent to strategic points in the city.



Her Majesty, Queen Elizabeth II, steps to the twin microphones at Farm Cove, Sydney, to deliver her first speech on Australian soil. At the rear is H.R.H. the Duke of Edinburgh and, on the left, the Lord Mayor of Sydney.

Crowds streaming from one vantage point to another, congestion in Martin Place, congestion at railway stations, how the yachts dispersed from the welcome lanes . . . these and many other things that you read about.

Broadcast coverage of the event was a triumph of organisation, with both national and commercial stations co-operating. It was the culmination of three years of preparation and six months of intensive work.

Under J. A. Tuite, Divisional Studios Engineer for the PMG, technicians had faced the task of equipping no fewer than 24 vantage points from which the program would originate and four receiving stations for mobile radio links. All this had to be routed through a central control so that everything could be merged into a single smooth-flowing presentation.

Some of the equipment was drawn from stock but a good deal of new equipment had to be built. At each point, the commentators needed an outgoing broadcast quality channel, as well as full monitoring facilities, so that each knew exactly what the other had said earlier in the broadcast.

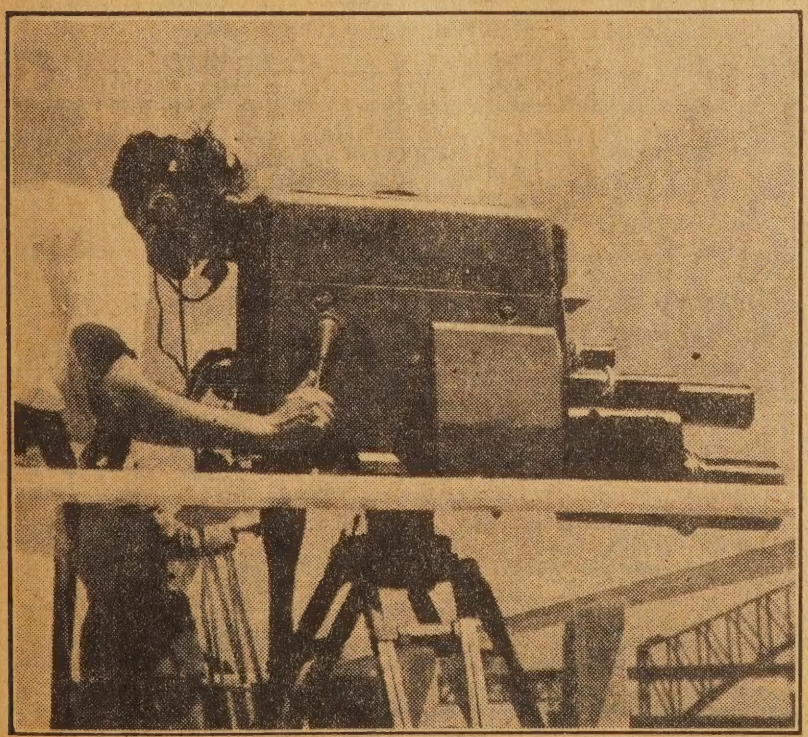
Trained personnel had to be drawn to man all these posts, which incidentally included an installation in an Auster aircraft and in a car in the Royal procession.

THE ANNOUNCERS

In the announcing staff one, Wynford Vaughn Thomas, came from the BBC, three were ABC announcers accredited to the tour, nine came from commercial stations and the remainder from the ABC's regular staff.

On the technical side, leave was cancelled to make available the full local PMG studio staff, added to which personnel were borrowed from Queensland. Many of the ABC's regular features had already been recorded beforehand for the period of the Royal visit, to avoid unnecessary calls on time.

When the Queen finally stepped ashore at Farm Cove, she faced two



A.W.A. Engineer, John Oyston, focuses the television camera on the historic scene. The radio link used was identical to that employed by the BBC for transmitting pictures from remote points back to the main transmitters for public broadcast. It is manufactured by the Marconi Company.

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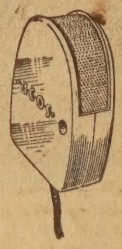

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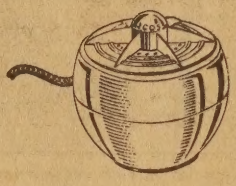

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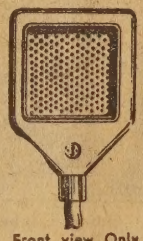

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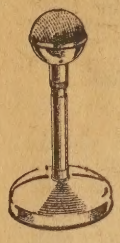

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MIC.3-5	„ „	„ „ „ „ „	12db „ „ „ „	Mervyn	1 19 3
MIC.3-6	„ „	„ „ „ „ „	5db „ „ „ „	Myrtle	1 19 3

MIC. 6 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.6-4	General Purpose	2 1-32in dia. x 19-32 thick	20db Peak at 2250 C.P.S.	Margie	£1 19 3
MIC.6-6	„ „	„ „ „ „ „	5db „ „ „ „	Maudie	1 19 3
MIC.6-11	„ „	„ „ „ „ „	12db „ „ „ „	Mandy	1 19 3

MIC. 14 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.14-5	General Purpose	1 7-16in dia. x 11-32in thick	20db Peak at 3500 C.P.S.	Maxie	£1 19 6
MIC.14-11	„ „	„ „ „ „ „	12db „ „ „ „	Mitchell	1 19 6
MIC.14-12	„ „	„ „ „ „ „	5db „ „ „ „	Malcolm	1 19 6
MIC.15	Hearing Aid	0.9in dia. x 0.155in thick	30db „ „ 3000 „	Marlene	1 19 6
MIC.17	„ „	15-16 in sq. x 7-32in thick	30db „ „ 3500 „	Maggie	1 19 6
MIC.18	General Purpose	1 7-16 in dia. x 9-32in thick	20db „ „ „ „	Maisie	1 19 6

MIC. 23 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.23	General Purpose	1 3-16 sq. x ¼in thick	20db Peak at 3000 C.P.S.	Maureen	£1 19 3
MIC.23-3	„ „	„ „ „ „ „	5db „ „ „ „	Margaret	1 19 3
MIC.23-4	„ „	„ „ „ „ „	12db „ „ „ „	Milton	1 19 3
MIC.32	High Quality	1 13-16 dia. x 9-16in thick		Martin	2 15 6

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simple microphones on the one stand . . . that was all.

One, which was actually open, fed through battery-operated equipment to a landline and thence to the splitting amplifiers. From this point everyone drew their signal—national stations, commercial stations, newsreel cameras, television, public address systems, recorders, short-wave stations, even to the BBC.

Had anything gone amiss with that microphone or channel, the other one would have immediately been cut into circuit feeding an entirely independent amplifier and line.

The need to duplicate lines and equipment added enormously to the task of PMG technicians. In a few cases they even had to duplicate installations, where the venue of functions depended on weather conditions.

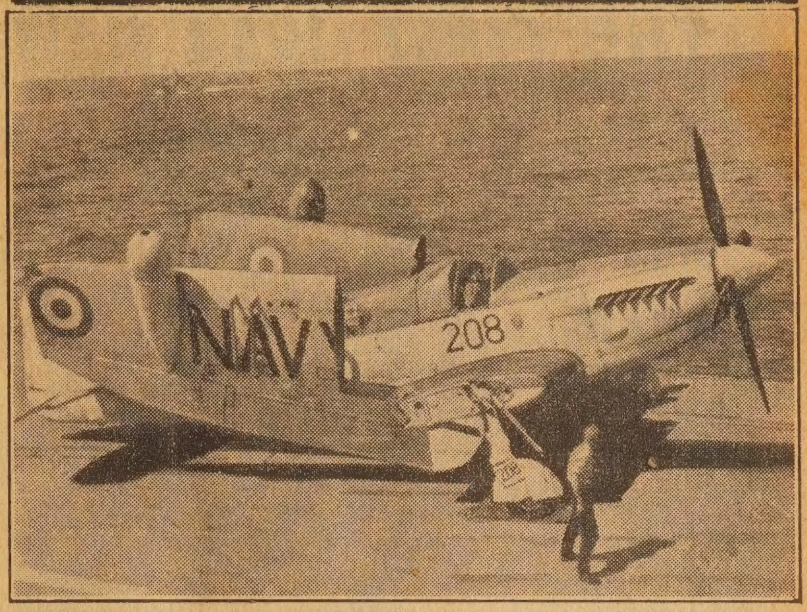
AND TELEVISION

According to estimates, the NSW tour alone involved 3000 miles of landline and sundry radio circuits to link studios to more than 120 separate locations.

Thirty miles of magnetic tape were used as well as a large number of transcription discs.

Much of the recorded material was later edited, sent by radio-telephone to London and broadcast immediately by the BBC to home listeners.

PICTURES BY RADIO, TELEVISION



Sent from the aircraft carrier Vengeance, in mid-Tasman, to the office of the Sydney Sun, this radio picture shows one of the planes getting ready to take off.

And here is the picture on the TV screen, as seen by crippled and spastic children, gathered around receivers installed for the occasion. Intensive work by a group of AWA engineers allowed hundreds of hospital patients to view various functions during the Royal tour of Sydney, including scenes inside Parliament House.

In fact, because of the difference in time, listeners having breakfast in London heard what the Queen had already done later in the same day.

At the landing stage and at various other points, spectators had, many for the first time, their first glimpse of a modern television camera. As the operator used first one, then another of the lenses in the multiple turret, fortunate viewers were able to see the whole spectacular scene, followed by intimate close-ups of the Queen and the Duke of Edinburgh.

This and similar equipment had been used many times before, but on February 3, for the first time in Australia, signals were officially transmitted to remote receivers by a radio path.

The success of the limited coverage and the enthusiasm of those who saw the pictures may help to speed the day when television will begin as a regular service.

So the day of February 3 drew to its close. The sun set in the west and the stars winked out.

Suddenly, with a burst of color, the fireworks display on the harbor had begun. From ships, pontoons and islands, star shells shot into the sky to light the foreshores and over a million upturned faces.

Magically, it seemed, the whole pattern of color changed in perfect synchronism. But it was magic! Those responsible for the pyrotechnics were simply co-ordinating their actions—by radio.

TELEVISION was the Cinderella coach which transported more than 200 children to the glittering Royal ball and their Fairy Queen. My "partner" for the ball was Judy, five years old.

The television wasn't supposed to start until 9-30 but who will blame the engineer who turned the switch that sent over, for nearly an hour, the scenes picked up by the camera crews—the waiting crowds, the arriving guests and the waterfall cascading in the ballroom?

The lack of sound puzzled Judy and when I explained that this was a camera rehearsal without sound, she took matters into her own hands and began to sing. Soon, the soft voices of the children in the beds around the glowing screen took up the chorus.

As the vital hour approached with the camera working overtime in a light no film camera could possibly operate in, Judy's hand was gripping mine very tightly.

There was a tense hush as the camera swung dramatically to the clock above the ballroom.

Conscious of the tense hush, I glanced around. By some miracle, there were now three and four children snuggled in and on the bed—there was even an impishly dimpled face peering from under it.

As Her Majesty walked down the ballroom a soft murmur came from 200 little people she could not see but who watched her every move.

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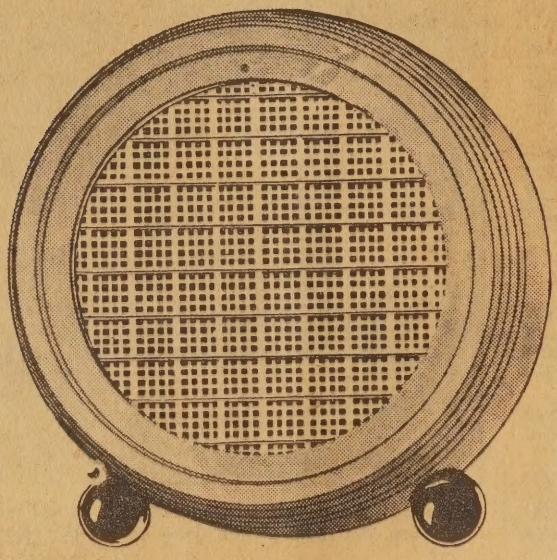

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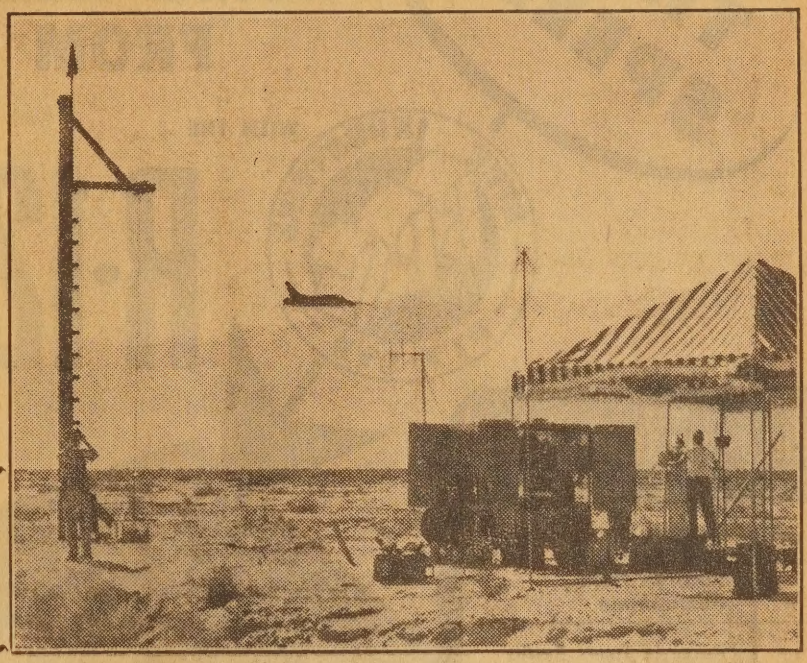
TIMING A WORLD SPEED RECORD

In a spectacular series of officially timed flights, top line fighters of the RAF and USAAF have carried the world speed record right up to the sound barrier. From Salton Sea, California, comes the story of a record run by the F-100, blood brother to Australia's Avon Sabre.

TIMED by specially devised equipment, Lt. Col. F. K. (Pete) Everest, 33, made two separate attempts at the record, one over a standard 3-kilometre and the other over a standard 15-kilometre course.

Over the 3-kilometre course, Colonel Everest put up an average speed of 757 mph, slightly bettering the figure of 753.4 established previously over a similar course by the US Navy F4D "Skyray". The margin was less, however, than the requisite 1 pc.

Colonel Everest subsequently transferred to a nearby 15-kilometre course and, with the temperature gauges reading 87 degrees, slammed the Super Sabre across the course in two blistering runs of 767.276 and 742.684 mph. This gave a sufficient margin over previously timed runs over 15 kilometres and also bettered the 3-kilometre figure.



As the Super Sabre flashes across the course, an official timer tracks the plane's flight allowing photographs and timing marks to be recorded simultaneously, thus obviating all chance of error.

After the run, official National Aeronautic Association Timer, Bertrand Rhine, Los Angeles, said the 15 km. average of 754.98 would be submitted as the new world's speed record.

He explained that, under Federation Aeronautique International rules, the fastest average speed for either the 15 or 3-kilometre course is recognised as the top official world's mark. (The FAI is the international body which regulates all air speed records.)

Colonel Everest flew nearly 18 miles in setting the new mark over the 15-kilometre course compared to a total of 7.2 miles for a 3-kilometre record.

Said Everest: "This 15-kilometre course is a tough one to fly because at least half of it is over water and it is difficult to pick out landmarks.

"It's much harder to hold a steady course for such a long distance."

Billowing black smoke marked each end of the course and the shoreline at the north end of the site to guide Colonel Everest in his runs. Official timing was with a Speed Graphic Pacemaker camera with Polaroid Land Backs and an electronic counter chronograph.

The complete panning mechanism was designed and built by a North American.

Pulling up after his first pass within a few minutes after take-off from El Centro Naval Air Station, Colonel Everest made a sweeping turn and headed his plane toward the course. "I'm going to kick her in the tail," he radioed. Seconds later the F-100 flashed across the finish line.

Although racing rules permit the 15-kilometre course to be run at any altitude Colonel Everest held the F-100 within 100 feet of the ground on both passes.

The F-100, recently demonstrated to the Press at Palmdale, Calif., is the air force's first jet fighter capable of breaking through the sound barrier in level flight at altitudes where it will fight.

The Super Sabre is powered by a Pratt and Whitney J-57-7 turbo-jet engine with afterburner. It is 45 feet long, 14 feet high and has a wing span of 36 feet. It has a service ceiling above 50,000 feet and a combat radius of more than 500 nautical miles.

Colonel Everest, who is Chief of the Flight Test Operations Laboratory at the Research and Development Command's Edwards Air Force Base, California, is a World War II ace. He has more than 4500 hours of flying time, a great portion of it testing and evaluating air force planes.

He has flown all current production models and research and development aircraft.

Here is plane number 50,001 as it came off the North American production line. A Super Sabre, it is claimed as the world's first operational aircraft to exceed the speed of sound in level flight.

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IS THE EXTRA H.P. DANGEROUS?

"Competition among car makers to increase engine power is a race with death. The power far exceeds manoeuvrability. The public appears to have gone quite power mad." This is the opinion of many U.S. authorities but it is not shared by George Koether, automotive editor for Look magazine.

BY GEORGE KOETHER

NEITHER does Koether agree that "the accident rate goes up with exceptional engine performance", as claimed by many authorities.

Says Koether: If all this is true, the public should call a halt to the "horsepower race", and Detroit engineers should stop packing more power into their engines and, presumably, luring more and more motorists to sudden death.

If it is not true—and if proposed laws to place governors on motor cars and so limit their performance are dangerous—then the public should know it. What are the facts?

The facts are (1) that greatly increased horsepower has brought no appreciable increase in average highway speeds; (2) that high speed is not the cause of most auto accidents; and (3) that vehicle operation has actually become safer as more horsepower has been put into engines.

INCREASE IS SMALL

The confusion over the effects of "high horsepower" results from a widespread misconception that one added horsepower gives one more mile per hour.

As motorists see horsepower ratings rising, they assume, erroneously, that top speeds are increasing at the same rate.

Actually, between 1930 and 1942, automotive horsepower increased 53 pc—and another 19 pc between 1942 and 1954. Yet, the top speed of the fastest 1953 car was only 5 mph greater than the top speed of the fastest earlier model.

Comparing the average top speeds of 48 models of all makes of cars in 1941 and of 55 models in 1953 shows an increase in average maximum speed of only 4.2 miles per hour. What the critics do not realise is that about five additional horsepower are required for each one-mile-per-hour increase in top speed.

REAL REASONS

Why, then, the ever-increasing horsepower? Say the engineers: "To improve acceleration and hill-climbing ability, to increase fuel mileage and cut engine wear." Their achievements bear them out. So do the accident statistics.

Improved acceleration in the middle-speed speed ranges—ability to pass rapidly—is a definite safety factor. For example, one 1953 model of 125 horsepower required 18 seconds to accelerate from 0 to 60 mph. This year, that same car, with a new engine of 161 horsepower, accelerates over the same range in 15 seconds.

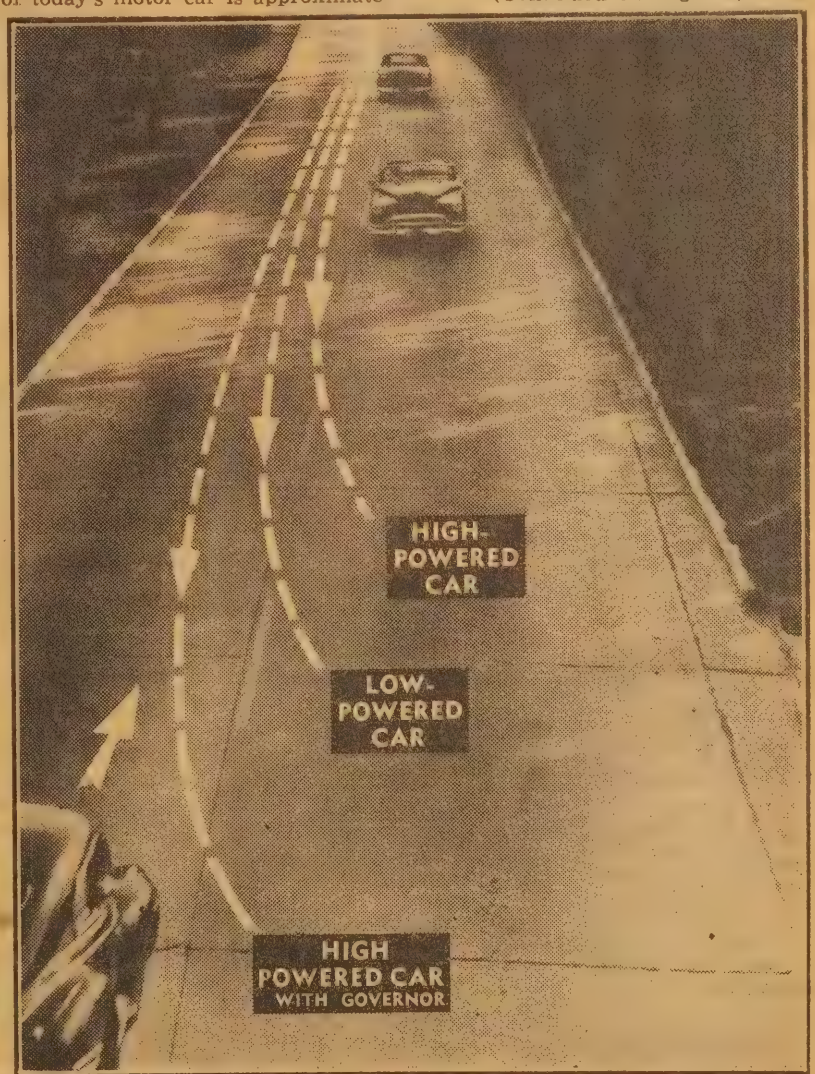
Those saved seconds can make the difference between life and death in a tight squeeze on the highway.

As for economy, the petrol consumption of the average car at a cruising speed of 40 mph has improved from 15 miles per gallon to almost 20 miles per gallon between 1930 and 1952—more than a 30 pc increase in economy even while cars have been getting larger, more comfortable and more efficient.

As for reduced engine wear, it is estimated that the service life of today's motor car is approximately five times that of 30 years ago A car of high horsepower can cruise at medium speeds with less engine wear and greater fuel economy, just as an aeroplane, using its full power only on take-off, cruises in flight at far less than its full horsepower.

And in automobiles, as in aeroplanes, the reserve of horsepower is a safety factor which the motorist can call upon in sudden need. The few extra miles of top speed are

(Continued on Page 83)



In this familiar situation, a high-powered car could accelerate past the one in front in comparative safety, even though its speed after the manoeuvre need not be excessive. A moderately powered car would have nothing to spare (centre line) while the governed car would be in trouble because of the motor's limited rpm.

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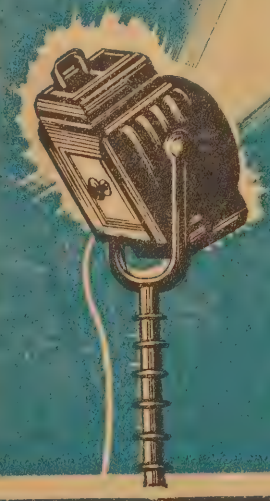

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THIN WINGS FOR HIGHER SPEED

New engineering methods have made possible the production of strong but very thin wings. These, in turn, will provide the key to speeds of 1000 to 1300 mph—higher than seems practical with delta-winged aircraft. Such is the opinion of C. L. Johnson, chief engineer of the Lockheed Aircraft Corporation.

ADDRESSING a recent conference, Johnson discussed delta, swept-back and straight-thin wing shapes, describing their advantages and disadvantages at various speed levels from subsonic to high supersonic.

The Lockheed engineer emphasised that the true relative performance and structural qualities of wing types can be established only by comparing them under conditions of equal military load, mission and takeoff-landing facilities.

Lockheed tests on comparable models, supported by production experience, indicate that top performance can be had with straight, razor-thin wings at speeds between Mach 1.5 and Mach 2. Such wings, long considered impossible to build with adequate strength, are now a definite reality, according to Johnson.

HIGHER SPEEDS ?

Sweptback wings have done good jobs at subsonic and transonic speeds but will encounter problems as more powerful engines make possible speeds up to twice as fast as those of most present fighter aircraft.

Thinness of the wing is the key to high supersonic performance, Johnson said.

New design and production techniques have solved once-troublesome flutter and strength problems for very thin wings. It is now possible to produce superior wings, straight and razor-thin in shape, with a maximum thickness of only one-fourth that of present conventional wings.

Wing sections once made of hundreds of small parts have been replaced by single pieces of higher strength metal, precision carved by automatic milling machines to gain aerodynamic and structural qualities never before achieved, pound for pound.

Describing swept wings as good in the high-subsonic and transonic speed ranges (700 to 900 mph), Johnson said they become relatively heavier, harder to build and subject to unsatisfactory flutter, loss of lift and instability under certain conditions of combat manoeuvring.

DELTA WINGS

On deltas, Johnson listed these points:

1. Delta wings must be necessarily large, in relation to the overall plane, for reasonable takeoff and landing runs, since their lifting ability is low until ground speed is high and the nose is pointed well up. The high lift needed at takeoff and landing complicates the landing gear and hampers the pilot's vision.

2. With larger wings and tails, compared with equivalent types, deltas have relatively greater surface area, which tends to retard speed.

3. Lockheed wind-tunnel tests showed that deltas with both single and double vertical tails became unstable directionally before the wing attained its maximum lift, while straight-thin-winged models remained stable even after stalling.

4. Use of trim devices to counter deltas' supersonic diving tendencies resulted in a higher drag, or air resistance, than on straight-wing types.

Illustrating unusual supersonic phenomena, Johnson declared Lockheed has discovered that doubling a plane's speed from Mach 0.8 to Mach 1.6 increases its drag more than five times.

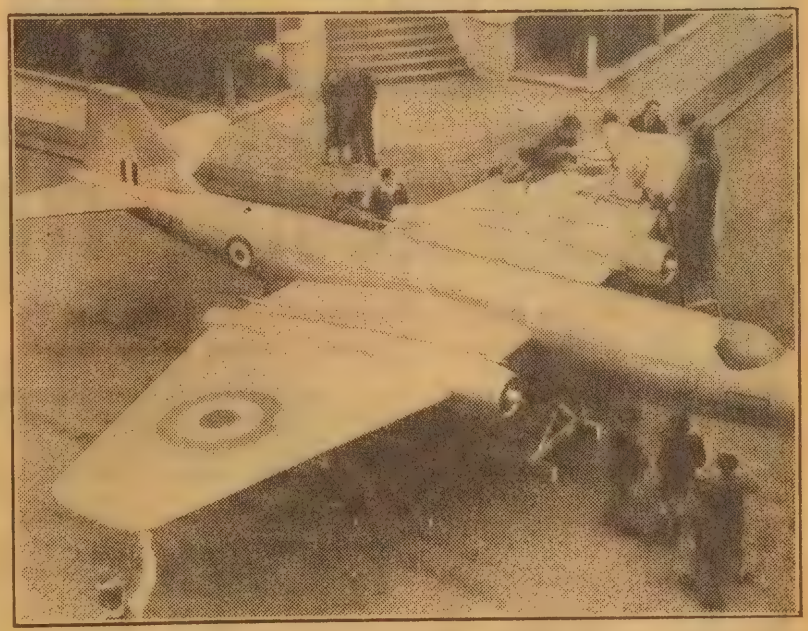
Tests showed that reduced wing thickness markedly decreased drag. At Mach 1.5, a 3 pc wing (thickness 3 pc of chord) had only 63 pc as much drag as a 5 pc wing.

Lockheed jets have all been straight-wing craft, except for the company's two XF-90 twin-turbine, experimental, transonic ships. Construction was started on a Lockheed delta design "a number of years ago", Johnson said, but was abandoned in favor of a straight wing design.

A new "air superiority" fighter, the XF-104, is now under construction, but details of its shape have not yet been disclosed by the US Air Force.

Jets will continue to use engines with auxiliary after-burners for additional thrust for extra-high speed, Johnson reported, rather than having single engines incorporating all the potential power now gained with afterburning. Such an all-in-one power plant would have unnecessarily large diameter and overall weight, he explained.

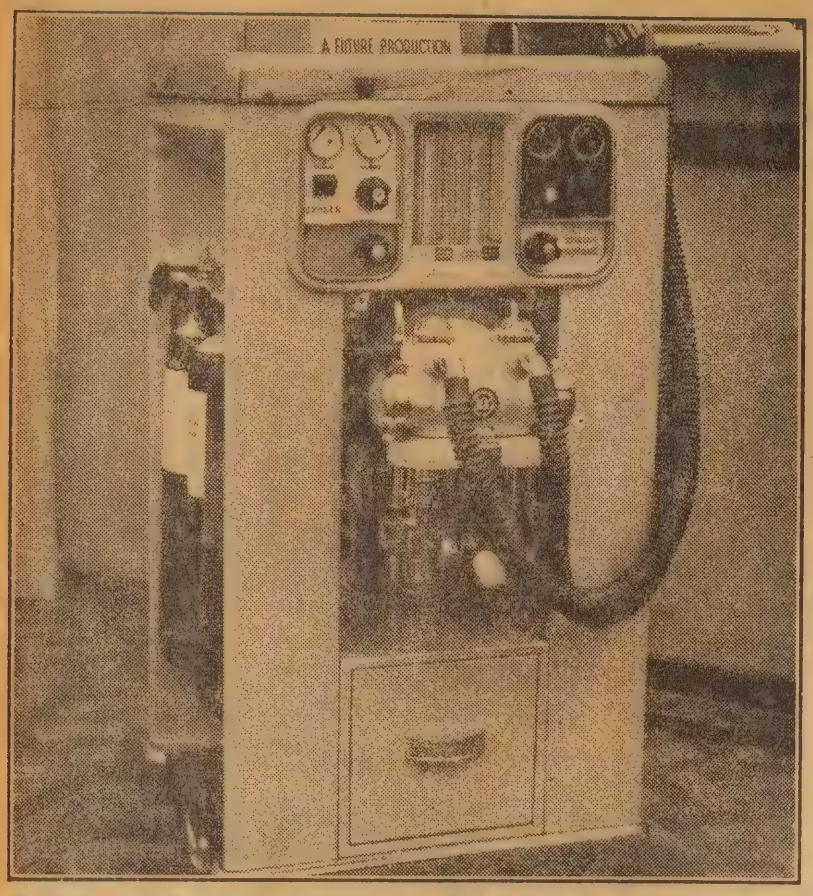
WORLD'S LARGEST MODEL AIRCRAFT



IN little more than two months, a team of six joiners built what is probably the largest scale model aircraft ever made in the United Kingdom. The model is a half size reproduction of the famous record breaking "English Electric" Canberra jet bomber.

More than 31 feet long and with a wing span of 32' 7" the model is actually about as big as a Spitfire. It embodies all the main external features including "Perspex" details of the Canberra Bomber. In its Royal Air Force livery of silver and grey it was a feature of unusual interest at the last Paris Aero Show, not only because of its great size but also as an outstanding example of British craftmanship in the field of model making.

Before a start could be made on the model, which weighs a ton, representatives of the firm of model makers visited the English Electric Company's works at Preston, Lancashire, where Canberra bombers are manufactured and they at once decided that their best approach to the model would be to build up the skeleton framework so as to correspond approximately to the basic structure of the actual aircraft. Some 600 to 700 drawings were used and the materials consist almost entirely of timber, hardboard and synthetic adhesives. The outer cladding is aircraft plywood.



Shown at a medical exhibition in England, this machine is designed to remove any guesswork from the job of administering an anaesthetic. Several gases are available, the pressure and flow being shown directly on meters.

SURGERY LOSING ITS TERRORS

The great advances made in the uses of anaesthetics and the techniques of their application has been one of the greatest boons to suffering humanity.

by Calvin Walters

THE term "anaesthesia" is a Greek one meaning "lack of sensation" and is used to denote a lack of sensibility to external impressions of the whole or part of the living body.

Before the advent of anaesthetics the performance of a surgical operation was a gruesome affair. Pain was the barrier which the surgeon had to penetrate before his knife could become an instrument of cure.

It is quite understandable that many a sick person of those days would rather die (and did) before he would submit to the terrible ordeal of being cut about while still conscious.

ROUGH BUT EFFECTIVE

Although there is no evidence to support the view, it is easy to conceive of physical means being employed to render a "prospect" unconscious by such simple means as a blow on the head with a heavy mallet, a punch on the jaw, a kick in the solar plexus or partial suffocation by choking.

Even these drastic measures, although preferable to a cold-blooded dissection, would require some fortitude on the part of the patient for the hardest-headed and most nerveless individual could hardly stand with equanimity to face such an onslaught.

One effective method of inducing at least partial anaesthesia was to become thoroughly "soused" with alcohol. The beginning of such treatment is no doubt pleasant enough, even if the later stages are somewhat doubtful. Nevertheless, I have seen a painful operation performed on the hand of a man who was "under the influence".

The possibilities of the anaesthesia induced on "bobby-soxers" by the application of the crooners of the Johnny Ray type deserves some investigation. When such performers can produce such insensibility to outside impressions and sometimes induce swooning, there would appear to be some merit in the employment of them in the operating theatres of hospitals. What a combination it would be—x-rays, violet rays and Johnny Rays!

Strange as it may seem, pain is one of nature's life-preservers. It is the alarm which warns the living being of danger by advance information of something gone or going wrong in the human system. This kind of pain is, of course, distinct from that deliberately produced by cutting, as with a knife or the extraction of a tooth.

PAIN IS SIGNAL

Pain is mostly, but not always, an accompaniment to disease, and many lives would be saved if there were pain in the early stages of cancer. The fact that this is not so is the worse for mankind in his fight against this terrible scourge.

It would seem that certain pain-relieving drugs were known to the ancients. Many of the Greek poets mention the taking of such drugs as opium, mandragora, curare, and so forth. However, it would appear that these were more used in poetry than in surgery, for Greek medical writings contain no record of operations being performed under anaesthesia.

The Chinese were reputed to have used some kind of pain-killer, as also were the Hindus and Arabians and other Eastern nations. There is considerable evidence to support the truth of this, but the methods used were the same old drugs and healing oils, no doubt aided by incantations, black magic and a few blows on the back of the head.

SOME STOUT CORDS . . .

Notwithstanding all this, it appears that right up to the time of the discovery of the anaesthetic properties of nitrous oxide, the accepted method of amputating a leg was to bind the patient to a table with ropes and straps, sit on his chest and having thus rendered him immobile go ahead and saw.

Having thus removed the offending limb the raw edges were seared with a red hot iron and the patient was then ready to leave hospital right away.

This method has so much to recommend it for operations on racketeers, urgers, income tax collectors and the like that it is a wonder it was ever abandoned.

There are three kinds of anaesthetics, general, local and spinal.

A general anaesthetic is one which renders the whole body insensible to pain. A local is one which renders a comparatively small area insensible to pain while a spinal will render a whole set of nerves insensible to pain even to the whole of the trunk or legs and so on.

General anaesthetics act apparently by depriving the brain partially at least of the ability to absorb oxygen. Much the same effect is produced by partial suffocation. The cerebral cortex is thus deprived of its ability to translate incoming impulses from the nerves into messages of pain.

Local anaesthetics put out of action the motor and sensory nerves at the point of application thus preventing any impulses from that area reaching the brain. The brain therefore has nothing to translate.

EFFECT WHOLE SECTORS

Spinal anaesthetics can be referred to as "general local" because they put out of action the centres in the spinal cord which "collect" the impulses from a whole section of the body.

General anaesthetics are of course taken into the blood stream either by breathing or by direct injection.

Among these "generals" are nitrous oxide or laughing gas, ether, chloroform, ethylene (not to be confused with ethyl in petrol), pentothal sodium (direct into blood stream) and many others.

Of these, ether is still the one most used because of its many advantages.

Ether has little effect on the blood pressure, respiration is full and regular and the relaxation of the abdominal muscles is complete. The principal drawbacks are its great volatility and the danger of abdominal distress after operation. It is nowadays mixed with oxygen during administration which reduces the nausea and vomiting.

BAD EFFECTS

Chloroform is about five times more potent than ether but it is more toxic. Because of its poisonous action on the liver and its bad effect on the heart, its popularity has declined. Chloroform slows the heart and may cause complications sufficient to stop the heart altogether.

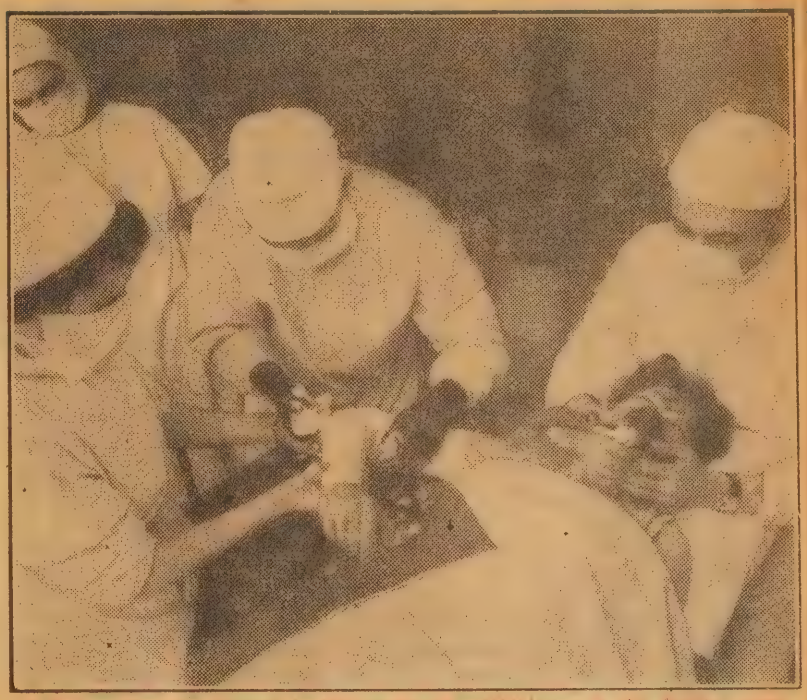
Intravenous (into the veins) of such drugs as pentothal sodium is becoming increasingly popular. It is perhaps the most pleasant way to take anaesthetic and the after effects are rarely not as great as a "hangover" after a night out.

Speaking generally, the administration of anaesthetic by means of inhalation through the lungs can be safer than that into the veins because, with the former, the process is as follows:—The more the ether passes into the lungs, the more of it is absorbed into the blood stream. When supply is cut off, the reverse takes place. The ether is given back to the lungs, along with the other products of exhalation, and is breathed out from the lungs. That is why the patient's breath smells of ether for a long time afterwards.

Thus the volatile drug is rapidly eliminated and, if an overdose is given, it can quickly be rectified, even to the use of artificial respiration in case of collapse.

On the other hand when an overdose is given of a non-volatile drug injected into the veins, it cannot so easily be dealt with. The effects of these drugs diminish only as they are eliminated by the kidneys after a breaking down process in the body. This takes a considerably longer time than is required with volatile drugs.

The need for an effective antidote for these drugs is an important line of investigation. Nevertheless, so



A far cry from the ancient barber-surgeon establishment is this familiar scene in a modern operating theatre, where sleep peacefully while doctors set to plaster a fractured limb.

About 160 B.C. the Scythians were reported to use flowering hemp as an anaesthetic, hemp being the source of the drug marijuana. We won't take any responsibility for the two characters who posed this picture.

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50/-	DW29	4/5 16.50 Metres Unit.
144/-	DW37	5/6 R.F. Unit.
78/-	K117	4/5 D/W Coil Kit.
66/-	K121	4/5 B/C Coil Kit.
76/-	K122	5/6 B/C Coil Kit.
10/-	F125	6in Dia. Loop Aerial.
84/-	K124	1900 K.C. Tuning Kit.

BEAT FREQUENCY OSCILLATOR COILS

21/-	F140	455 K.C.
21/-	F141	1600 K.C.
21/-	F142	1900 K.C.
21/-	F143	175 K.C.
21/-	F144	100 K.C.

FILAMENT AND AUTO TRANSFORMER

Retail Price		
20/6	TP55	6.3v. — 3 amp. — 15 watts.
23/-	TP56	12v. — 1.5 amp.
18/-	TP80	6.3v. 4v. and 2.5 auto.
23/-	TP57	4v.
23/-	TP58	7.5v.

POTENTIOMETERS

		Ohms.	M/A
9/6	PT37	4	250
9/6	PT40	6	250
9/6	PT38	10	250
9/6	PT39	20	250
9/6	PT36	25	250
9/6	PT34	30	250
9/6	PT41	50	200
9/6	PT42	100	100
9/6	PT44	400	50
9/6	PT47	1000	35
9/6	PT48	1500	35
9/6	PT49	2500	30
9/6	PT50	3000	30
9/6	PT51	5000	30
9/6	PT52	10000	25

SPEAKER REPLACEMENT WINDINGS

Primary		
7/-	F132	Single Triode.
7/-	F133	Single Triode.
7/-	F134	P/P Triode.
7/-	F135	P/P Triode.
7/-	F136	Single Pentode.
7/-	F137	Single Pentode.
7/-	F138	P/P Pentode.
7/-	F139	P/P Pentode.

SPEAKER TRANSFORMERS Primary

16/-	TS23	Single Triode.
16/-	TS24	Single Triode.
16/-	TS25	P/P Triode.
16/-	TS26	P/P Triode.
16/-	TS27	Single Pentode.
16/-	TS28	Single Pentode.
16/-	TS29	P/P Pentode.
16/-	TS30	P/P Pentode.

5 BAND COILS

111/-	K120	Coil Kit. 15 Coils.
7/-	H124	10 Metre Aerial.
7/-	H125	10 Metre R.F.
7/-	H126	10 Metre Oscillator.
7/-	H127	20 Metre Aerial.
7/-	H128	20 Metre R.F.
7/-	H129	20 Metre Oscillator.
7/-	H130	40 Metre Aerial.
7/-	H131	40 Metre R.F.
7/-	H132	40 Metre Oscillator.
7/-	H133	80 Metre Aerial.
7/-	H134	80 Metre R.F.
7/-	H135	80 Metre Oscillator.
9/-	H136	B/C Aerial.
9/-	H137	B/C R.F.
9/-	H138	B/C Oscillator.
7/-	H139	15 Metre M.C. Aerial.
7/-	H140	15 Metre 21 M.C. R.F.
7/-	H141	15 Metre 21 M.C. Osc.
63/8	SW17	3 Gang Coil Switch.

SHORT WAVE COILS

6/8	H121	16.50 Metres 1/C Aerial.
6/8	H122	16.50 Metres 1/C R.F.
6/8	H123	16.50 Metres 1/C Osc.

FILTERS

37/-	LF20	Line Filter. ½ amp.
42/-	LF20C	Line with Condensers.
50/-	LF24	Line Filter. 2 amp.
55/-	LF24C	Line with Condensers.
13/6	K123	10 K.C. Whistle Filter Coil.
140/-	AF21C	Aerial Filter Complete.

much experience has been gained in the use of these drugs in wartime that the danger is probably not great and there is no need for alarm if your doctor uses the intravenous method of anaesthesia to remove your unwanted parts.

Some of the ceremonial that goes on in a hospital ward prior to an operation has puzzled many people. It is perhaps a good idea if I were to explain some of it.

Firstly, one is all dressed up in socks and masks, etc., and previously given a purgative, the reason for which is obvious.

Next, along comes a nurse and gives a "needle," which is taken usually as a matter of course. Nursie is very nice. There is always something attractive about a nurse. Maybe it's the uniform. She talks soothingly to you, cracks a joke, takes your temperature and clears out to the next patient.

Now, all this business is called "premedication," so you can say you have been "premedicated."

TWO DRUGS

In the "needle" was most probably two drugs. One is usually morphia, which allays fear and relieves any pain one may be in at the time. It also depresses the rate at which the body is working and renders it more susceptible to the anaesthetic. It also reduces the amount of anaesthetic required, which is an advantage, because it is less costly to the doctor and you pay the same money for less anyhow! But the less anaesthetic you take the better for your constitution, so why worry?

Although there are a couple of disadvantages with morphia, these are of minor importance compared with the feeling of happy indifference induced in the most nervous patient.

The "needle" also probably contained a drug like atropine, which dries up the secretions of the respiratory tract. Ether and most other inhalation drugs are irritating to the nose and throat and therefore induce an abnormal flow of saliva.

This would be disadvantageous, as the secretions from the glands in the lungs would interfere with the free transfer of oxygen and ether from the lungs into the bloodstream. The patient could choke easily, also.

Another thing, no self-respecting doctor likes to have his hands inside the abdomen of a person who is dribbling all the time. It is a most disgusting sight.

Hyoscine is often used in place of atropine. It has the same effect as atropine and is also a sedative and aids the morphia.

Sometimes very nervous and restless patients are sent off to sleep by means of "basal narcosis." This is really a form of very necessary trickery in order to get the patient into the operating theatre without trouble. It usually takes the form of an innocuous enema of salt and water each day for two or three days before the operation.

On the day of the op. this is replaced with an enema containing a drug, such as paraldehyde or bromethol, or avertin.

The patient becomes drowsy, falls off to sleep and wakes up in the same bed with his leg off, or whatever the op. was for, not knowing he ever left the bed. Smart, isn't it?

Local anaesthesia, especially that branch which concerns spinal anaesthetics, is a highly specialised business. It is possible today to render the whole of say the lower portion of the body insensible to pain to such an extent that the doctor can delve about on the "insides" while the patient reads the paper. Every now and again the patient can ask, "How yer doin', doc?" and the doc. can give a running description of what he is up to.

This form of anaesthesia, besides being a tedious business for long operations involving advanced modern techniques, is not one to be used on the nervous and impatient. The drugs used are mostly of a toxic nature, and, taken, all around, most of us would prefer to be asleep while the job was on.

The apparatus used in modern anaesthesia would require a long treatise, and has not been touched on here for that reason.

The most modern methods, not yet widely used, but becoming more common, uses electronic apparatus, which meters practically everything going on within the patient during the operation. It registers blood pressure, heart action, brain waves and heart waves and impulses, and so on.

Such apparatus is very costly, but remarkably efficient. In a few years' time it will be quite a pleasure to be operated on. One can imagine the conversation at a ladies' bridge party: "You know, my dear, mine was a most unusual operation. The doctor told me that my alpha brain rhythm had a wavelength of one millionth of a centimetre. The psycho-analytic machine showed I had a rhythmic ratio of 11.8 Unusually high for my temperament." Nerts.

Besides, what happens when all this circuitry starts picking up the ABC program, or Jack Davey?

TITANIUM IS A PROBLEM METAL

Never before have metallurgists directed so much activity in a short space of time to one metal as they have to titanium.

YET it is widely recognised that supplies of it threaten to be inadequate for some time to come. Why is it such a far cry from the present production of a few hundred tons a year to quantity output everyone wants?

Metallurgists say that all the major problems connected with the extraction, melting and fabrication of titanium stem from the fact that when hot, it reacts far too readily with other materials.

In fact, molten titanium attacks every one of the known refactory materials which are normally used for lining metal furnaces, and for making crucibles.

For this reason, very special equipment and new techniques for melting the metal have had to be developed — among them methods of melting in a vacuum or in an argon gas atmosphere.

Other problems include the fact that oxygen and nitrogen are soluble in titanium, causing it to become brittle and the high melting point of titanium — 1725 degrees centigrade.

These new techniques are, of course, necessarily more costly than the methods normally used for melting metals. However, although the present extraction process (the Kroll process) is a difficult and complicated one, British metallurgists describe the progress they have made in improvements to the process as "quite impressive."

NO LUBRICANTS

Commercially pure titanium can be hot-worked by forging, rolling, extrusion, and other conventional methods, but in general it is more difficult to cold-work than are most nonferrous alloys. The main reason for this is that titanium has an unfortunate tendency to seize on other metals during sliding contact with them under pressure.

So far no lubricant has been found which will prevent titanium and other metals in contact from seizing together — though it is possible to prevent metal-to-metal contact by oxidising the surface of the titanium or covering it with other substances.

Another problem which looms large, if not largest, in the economics of titanium production is that scrap metal cannot be remelted and returned to the production cycle.

This is partly because massive scrap cannot be fed into the small arc furnaces at present used for melting titanium, and partly because of contamination problems. Efforts are being made to overcome these difficulties.

Joining the metal is also a problem — especially the brazing, soldering and welding of titanium alloys. Commercially pure titanium can, however, be readily welded by electric resistance methods and also by argon arc techniques.

ALLOYS SHOW PROMISE

Among the materials which show promise of becoming good alloying ingredients with titanium are iron, chromium, manganese, molybdenum and aluminium.

The alloys that it has been possible to produce so far are much stronger than commerically pure titanium, but less ductile. They retain their properties better at high temperatures and have superior creep properties.

The alloys have excellent fatigue and anti-corrosion properties of titanium itself.

All in all, the experts are encouraging in the progress they report with handling this new metal, which has properties so necessary to aviation — as strong as steel through much lighter, and as non-corrosive as stainless steel itself.

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"Swiss craftsmanship at its finest!"

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WITH G-E VARIABLE RELUCTANCE PICK-UP AND SAPPHIRE STYLUS £46'15'-

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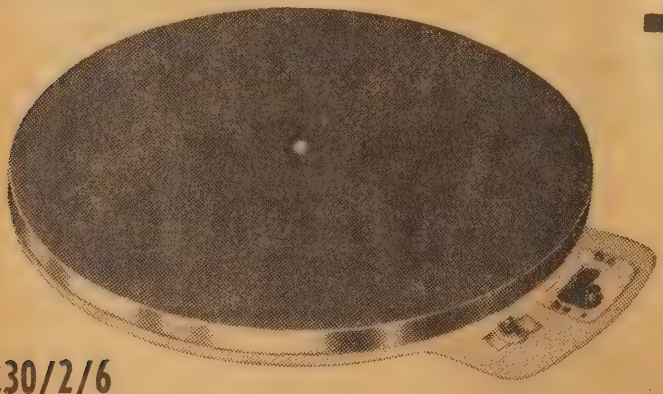
Styled to add beauty to any High-Fidelity installation. Rubber shielded shock mounting hardwares.



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- 12in cast aluminium turntable machined and balanced.
- Thick aluminium base plate.
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- Shock springs for mounting board.

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PRECISION TURNTABLE

A rigorously constant speed without flutter and wows. A unique speed change device using throughout precision finished worm and gears, a mechanical filter on the main shaft and a heavy 12in turntable assure a very low flutter and wow content.

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The speed selector allows continuous speed adjustment about each main position.

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Technical Review

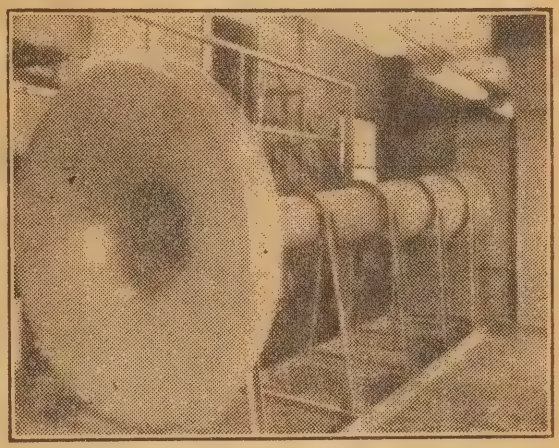
ACCELERATION TESTS FOR PROJECTILE EQUIPMENT

To study the effects of shock and acceleration under controlled conditions, the US National Bureau of Standards has recently set up a lot of new equipment, including a 91ft drop tower, air guns, wind-tunnel and centrifuges.

THE new equipment is used primarily in studying the effects of high accelerations — similar to those to which ordnance projectiles are actually subjected.

Major equipment housed in the Bureau's Air Gun Building includes two air guns, one of them 96ft long; a wind tunnel with a velocity of 300ft/sec.; and four centrifuges, one of which can produce acceleration of 60,000 g (g equals acceleration of gravity) on 1lb specimens.

☆



Intake of the wind tunnel, another important ordnance development facility in the NBS Air Gun Building. Air velocities up to 300 feet per second are available.

☆

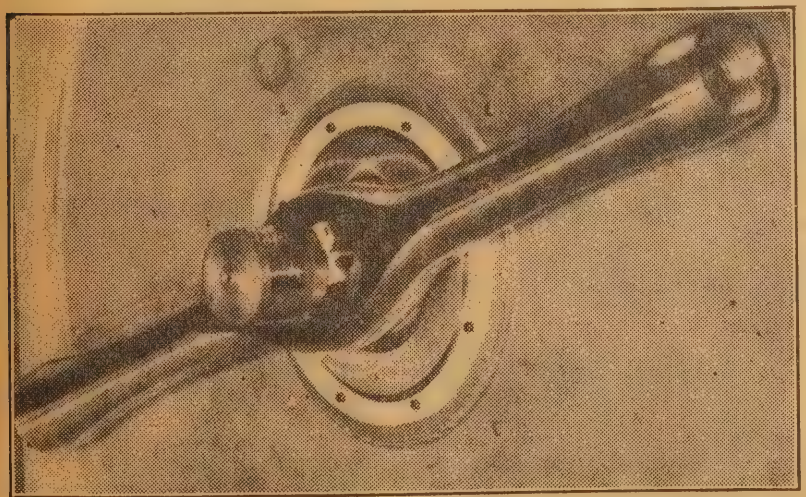
SHOCK IMPACTS

The drop tower, located near the airgun building, is for studying the effects of shock impacts on experimental objects. These impacts are obtained by dropping the objects on to various surfaces from known heights.

The bureau has had a variety of major assignments in weapons development for the armed forces.

It was at NBS that the first radio proximity fuse for non-rotating projectiles was developed during World War II and also, in co-operation with industry, the "BAT"—the first fully automatic guided missile to be successfully used in combat.

The bureau's laboratories are currently engaged in the development of various electronic and electro-mechanical devices that will withstand being fired in ordnance projectiles.



Arm of the NBS Ultra-High-g Centrifuge H1. An 8-cylinder 160-horsepower automobile engine, working through a step-up gear box, drives the 37-inch-long centrifuge arm to a full speed of 11,000 rpm. Accelerations of up to 60,000 g can be produced in specimens mounted in the ends of the centrifuge arm.

The large NBS air gun is constructed from eight 90mm gun barrels. The barrels are bored to 4in diameter, flanged, and bolted together to provide a straight length of 96ft. A wall thickness of 1in provides sufficient strength for great latitude in working pressures.

Design of the gun is noteworthy in that the acceleration forces are not caused by sudden application of a very high air pressure to the projectile.

Instead, low-pressure air gradually brings the projectile (containing the components to be tested) up to speed along the length of the long tube. Then, to produce the desired accelerating force, the fast-moving projectile is rapidly stopped by letting it plough into a catcher box filled with sand, lead, or other material.

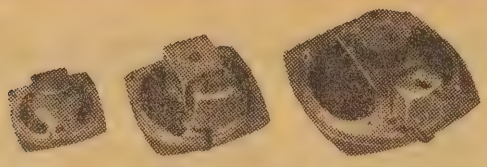
By using projectiles of different materials and shapes, by adjusting the propelling force to produce different muzzle velocities, and by filling the catcher box with different materials, a wide range of negative accelerations can be applied to the components under study.

AIR TANK

A 125-psi, 70 cubic ft tank, fitted with a quick-release valve, supplies the propelling air. Impact velocities of projectiles are determined either photo-electrically or by measurement of the time interval between the breaking of two wires.

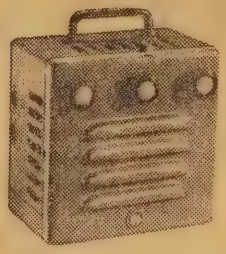
Typical projectiles weigh from 6 to 18lb, and attain velocities as high as 880ft/sec. Weight and speed are thus comparable to those of an actual ordnance projectile fired from

AWA MEETS YOUR P.A. REQUIREMENTS

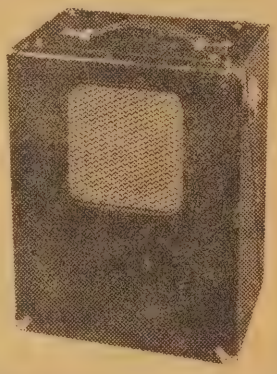


A.W.A. permanent magnet speakers are available in a range of sizes and types for every P.A. and sound reproduction need.

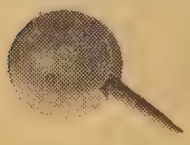
Amplifiers from five watts to seventy watts, for mains or accumulator operation, provide wide audio range reproduction, robust construction and reliable operation. Each model is built to the same high standards of quality workmanship and performance for which A.W.A. has established a world wide reputation in broadcasting and communication equipment.

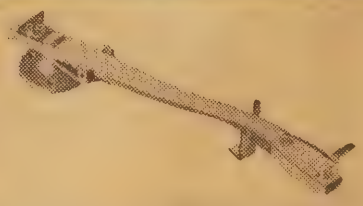


Portable address system model PA90 operates from mains or accumulator.

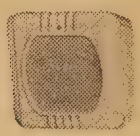


Pillowspeaker PS50 is a crystal type speaker for hospital or home use.

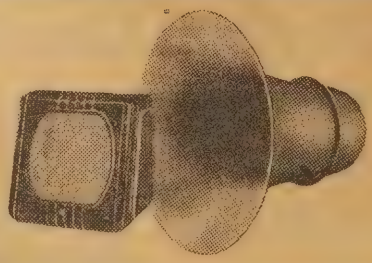




The A.W.A. Twin Jewel Transcription Pickup, designed to meet the exacting requirements of modern broadcast installation is the ultimate for audio system high fidelity reproduction of modern wide range recordings.



Attractive ivory and walnut housings for wall or table mounting, and flare housings for high efficiency and outdoor requirements are available to suit the various speaker sizes.



A.W.A. Sound Engineers will be pleased to survey your requirements and submit estimates for permanent installations. The Public Address Hiring section is equipped and staffed to meet any temporary need for sound amplification.

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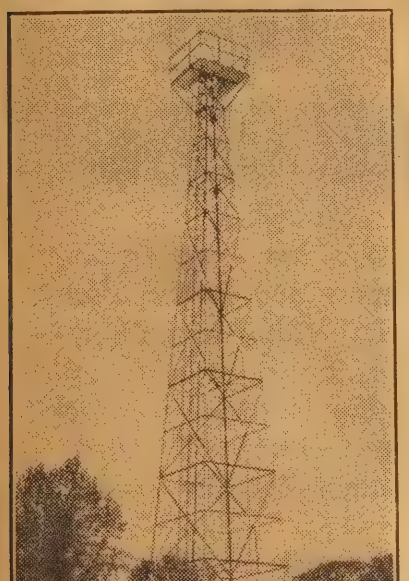
a weapon such as a trench mortar.

The steel test projectile smashes into a stack of lead plates in the catcher box with such force that it penetrates some 8in into the lead.

The NBS Ultra-High-g Centrifuge H1 will apply an acceleration of 60,000 g to two specimens weighing as much as 1lb each.

The specimens rotate in a 37in diameter circle with a full speed of 11,000 rpm. At this speed the specimens have a velocity of about 1200 miles an hour, and the force at the hub section is more than 830,000 lb.

The arm is machined from SAE 4340 steel heat-treated to an ultimate tensile strength of 176,000 lb-square inch, which was magnafluxed and x-rayed to insure freedom from imperfections.



Drop tower and Air Gun Building (low white building behind tower) recently constructed at NBS. These new facilities are being used in connection with the NBS ordnance development program in studies of the effects of high accelerations on experimental ordnance components. Studies with the new facilities show whether experimental objects can stand the shock of being fired in a projectile.

The 2in thick steel chamber in which the arm rotates is designed to be evacuated or filled with helium, if desired.

An 8-cylinder 160-horsepower automobile engine, working through a step-up gearbox, supplies the large amount of power needed.

Electrical slip rings are provided to transmit information from the component under test to recording instruments.

To minimise large unbalance forces caused by the very high rotational speeds, the arm-shaft-bearing assembly is mounted on rubber O-rings. This allows the assembly to seek its own rotational centre when acted on by an unbalanced load.

Means must be provided for measurement of dynamic unbalance that may occur over the entire speed range. This is accomplished by means of two strain gauges mounted on a beam over the drive shaft; the output from the gauges is fed to control oscilloscopes which show when serious unbalance occurs.

A reinforced concrete archway, 3ft wide by 6in thick, provides protection in the plane of rotation of the centrifuge arms.

HEAVY DUTY UNIT

A second unit, the NBS Heavy-Duty Low-g Centrifuge L1, was constructed to permit the testing of relatively heavy components—up to 150lb, including supporting fixtures—under the influence of relatively low acceleration forces, up to 100 g.

The ends of the arms of this big centrifuge describe a circle 29ft in diameter.

Power to drive the unit at speeds up to 165 rpm is provided by a 20-horsepower motor-generator set.

In addition to these two special centrifuges, H1 and L1, the building is equipped with a 1000 g and a 10,000 g centrifuge for work of a more routine nature.

The NBS Drop Tower provides a convenient means for elevating test objects to heights up to 87ft 8in and dropping them on to various anvils, steel, concrete, wood, or sand.

TEST POSITION

In the bottom of the tower is a small house, about 14ft square and 10ft high, for personnel and equipment.

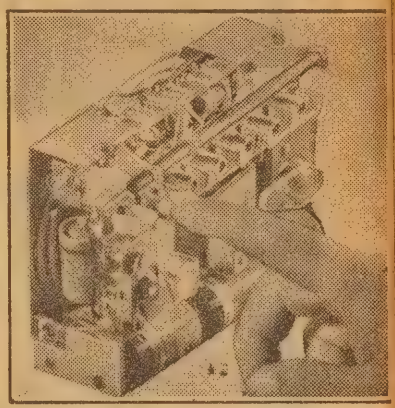
The object under study is mounted in a "dropping block" which is fastened to the carriage of a chain-drive elevator by means of an electrical bomb-release mechanism. When the elevator has carried the object to the desired height, the operator presses a button to release the dropping block.

Accelerometers may be fastened to the dropping block to measure the impact acceleration, and provision is made for several other types of instrumentation. Maximum impact velocity is 74.5ft/sec, or about 50 mph.

Acceleration as high as 50,000 g are obtained on impact.

"TRANSISTORISED" MANTEL SET

A compact experimental radio receiver that harnesses a new and greatly-improved type of junction transistor to provide sensitivity and fidelity comparable to conventional table model receivers several times its size has been developed.



Front and rear views of the experimental completely transistorised radio receiver developed at RCA Laboratories. The row of transistors is pointed out below.

SIX flashlight batteries will operate the laboratory receiver for at least 500 hours, according to its designer, Loy E. Barton, RCA research engineer.

The remarkable performance of the transistor-operated receiver is made possible, Mr. Barton said, by the development of junction transistors that provide useful amplification at radio frequencies as high as 10 megacycles, in contrast to previous junction types that usually perform well only at audio.

Before receivers of the type demonstrated can be produced commercially at reasonable cost, transistor techniques will have to be refined and new materials and associated miniaturised components will have to be developed and mass-produced, it was pointed out.

At the present stage of development, the cost of the transistors and of the new components would be far in excess of comparable mass-produced, tube types of receivers.

Though still in the laboratory stage, the new transistor is of relatively simple triode construction, thus giving promise of eventual quantity production. The large frequency span it opens up should broaden considerably the potential application of transistors.

Unlike its predecessor types, it can operate in IF (intermediate frequency) stages of AM broadcast receivers, and in the video amplification stages of television receivers.

The transistor receiver used in demonstrations by Mr. Barton has six transistors of the new radio frequency type and three experimental junction transistors of the audio-frequency range.

AUSTRALIA'S MOST POPULAR Radiogram Cabinet NOW made SUITABLE for INCLUSION of TAPE RECORDER

MODEL 508 C.T.
Length 5ft 3in, Width 20in, Height 32in.

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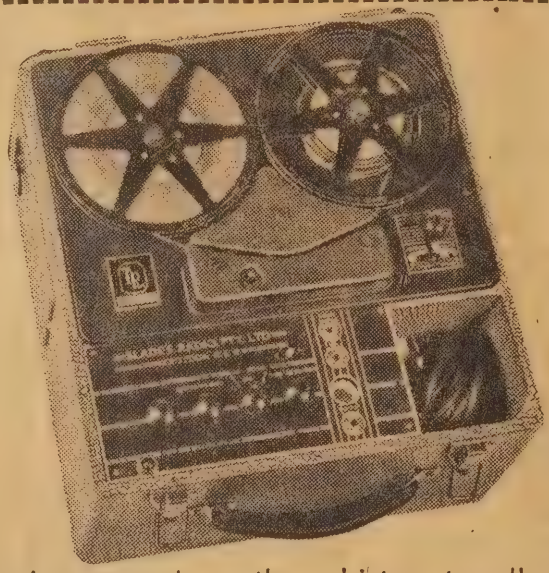

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The professional Quality Tape Recorder you have been waiting for. 40-8000 cycles at $7\frac{1}{2}$" per second assures perfect reproduction under all conditions. No more expensive records to buy. Record your own from the Radio Set, play them back as often as you like. Erase when you are tired of any particular tune and re-record another. Listen to all other Tape Recorders available but before making your choice compare the Slade Sound Mirror.

The ideal recorder for Music Teacher, Elocution Teacher or Business Man.
Price £146 Complete with Microphone, Tape and Free Tuition.

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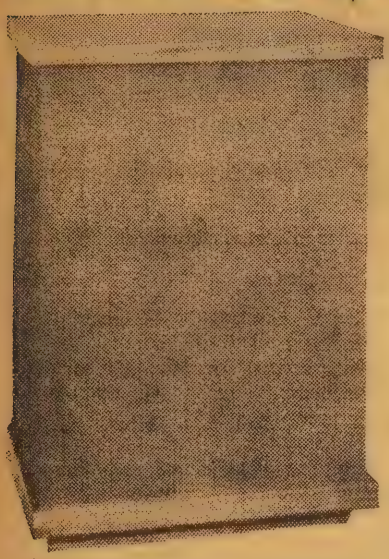


The commercial version of the horn as designed by Gately and Benham.

One of the most fertile fields for experiment in a domestic amplifier set-up concerns the design of the loudspeaker baffle. While it is obviously impractical for us to build and test all the suggested designs, this one might appeal to enthusiasts with a bent to carpentry.

DESCRIBED by Gately and Benham in the December, 1953, issue of *Radio and Television News*, the suggested design is a form of folded horn. It is being marketed commercially in the US under the name of "Purist".

One of the principal features of the horn is that it does not rely on the corner walls in a room to provide an effective continuation of the throat. It can therefore be placed along a wall, wherever the layout of the furnishings should dictate.

The appearance of the finished cabinet is such that it does not clash with either period or modern furnishings and the overall dimensions are not large, considering the nature of the horn structure.

Developed from earlier designs, the "Purist" horn has a mouth which exhausts on three sides. When placed against a wall, the wall and floor surfaces effectively increase the area of the horn mouth by what the authors describe as "the image" effect.

As apparent from the accompanying photograph and sketches, the "Purist" horn cabinet is essentially rectangular in shape and is faced, in the original version, with an open-weave material. Only the top and bottom are finished in wood.

The speaker mounts against the front of the cabinet, near the top, with a full-width partition sloping up behind it. The partition stops short of the top, however, providing a path for the back radiation over the top of the partition and down the rear wall of the cabinet.

In the base of the cabinet is a half-triangle structure which deflects the pressure waves downward and outward through ports at the sides and front.

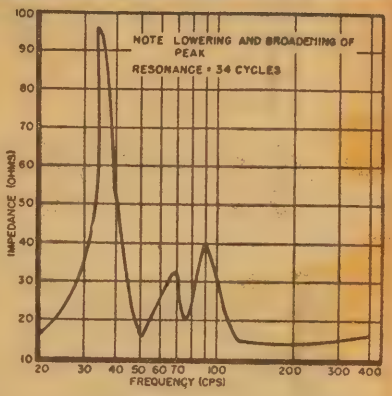
The dimensions as shown on the drawings are suitable for either 12in or 15in speakers, the use of the larger speaker merely involving a larger cutout and a slight alteration to its position.

It is suggested that the enclosure be made from ¾in plywood and that all joints be both screwed and glued, to prevent air leaks and rattles. Failure to seal all joints effectively will compromise correct operation of the horn.

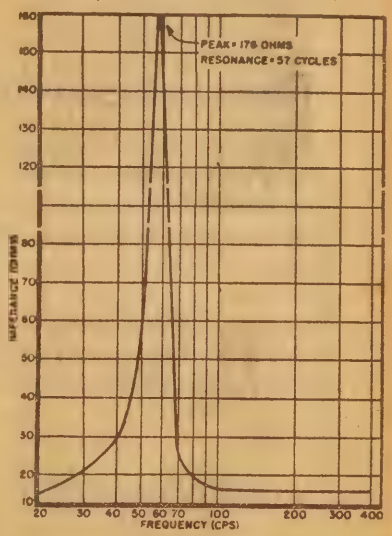
For access to the speaker chamber, the top could be made removable, using possibly a sliding tongue-and-groove fit. Irrespective of method, however, it is most important to see that it is airtight.

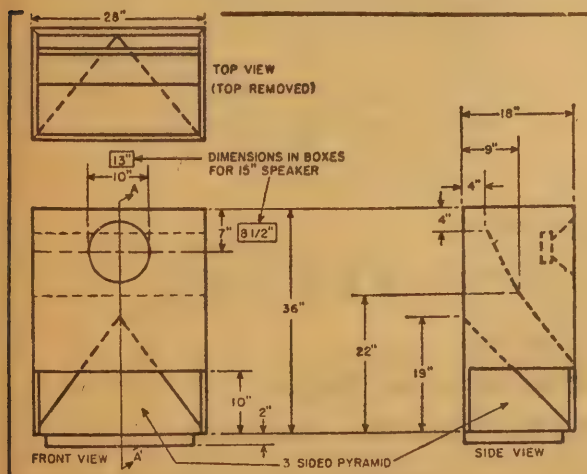
To damp local reflections in the cabinet, some interior padding is desirable, although the optimum amount is likely to vary with the type of speaker in use. According to the authors, inexpensive type speakers, with more obvious resonances, will need more padding than others.

In all cases, however, some padding of the parallel sides of the horn will be desirable.

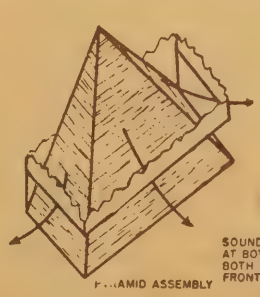


The impedance curve of a 15-inch speaker in an unpadded "Purist" baffle compared with the same speaker mounted in a padded "infinite baffle" of the same dimensions. Padding in the "Purist" would smooth out performance above 34 cps.



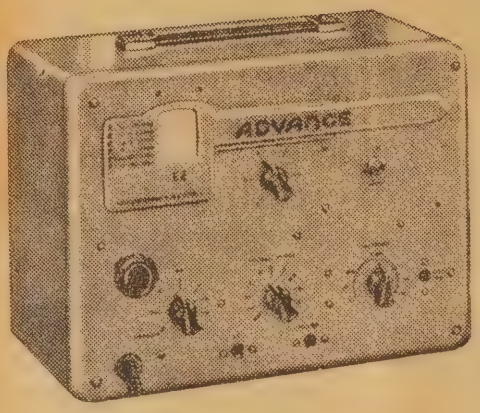


Complete mechanical details for building "The Purist" enclosure. Care must be taken to insure an airtight seal otherwise performance will be impaired. All joints should be both screwed and glued for rigidity.



PYRAMID ASSEMBLY

Advance SIGNAL GENERATORS



R.F. GENERATOR TYPE E2

Range: 100 Kc/s to 100 Mc/s in 6 ranges on fundamentals.

Accuracy: Frequency calibration plus minus 1%

Modulation: 30% at 400 cycles

R.F. Output: 1 uV to 100mV, continuously variable through 75 ohm matched transmission line. A steady output of 1 volt is also provided through a separate socket. Using the termination pad, output impedances of 37 ohms, 10 ohms, or 10 ohms through a standard all-wave dummy aerial may be obtained.

A.F. Output: Variable 0-12 volts at 400 cycles.

R.F. Leakage: Total stray leakage less than 3 uV at 100 Mc/s.

IMMEDIATE DELIVERY

"Advance" Signal Generators are designed and manufactured as precision instruments. The same high standard of workmanship is maintained right throughout the range, from ordinary radio service models to sub-standard types for research and laboratory use. They are widely used by Australian Government Departments and Defence Services as well as industry generally.

The two models illustrated are companion instruments designed to fulfil the needs of radio service and communications engineers and, between them, provide complete radio and audio frequency signal sources for all normal requirements. They are keenly priced and are fully guaranteed.

Write for detailed specifications

A.F. GENERATOR TYPE H1

Range: 15 c/s to 50,000 c/s

Accuracy: Frequency calibration plus minus 1% or plus minus 1 c/s

Output: Sine wave—200 uV to 20 volts plus minus 1 db
Square wave—400 uV to 40 volts

Rate of rise of square wave: Less than 3 microseconds to reach 90% of peak value at 10 Kc/s

Distortion: Less than 1% at 1,000 c/s

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Made by ADVANCE COMPONENTS LTD., England.

NEWS AND VIEWS OF THE MONTH

Gothic's transmitters

THE Gothic, which brought Her Majesty the Queen to Australia, is fitted with the largest transmitter ever installed in a merchant ship.

It is a 7-kilowatt transmitter for radiotelegraphy and telephony, and was supplied by the Marconi Co. of England.

The Gothic's radio requirements are particularly wide in their scope, including not only international and home communications, but also live broadcasts for use by the BBC and others, international communications, and even pictures transmission by radio. Secret "scrambled" speech facilities are also essential for secrecy.

Three powerful Marconi receivers work in conjunction with this transmitter, one to check outgoing signals, one to act as a traffic receiver (the earpiece of the telephone), while the third provides cueing facilities at the various BBC commentary points.

A choice of three separate entertainment programs from all over the world is relayed through the ship through 48 loudspeakers hidden in decorative fittings.

Programs of special interest received at inconvenient hours as the ship moves through the world's differing time-zones are taken on special recorders for re-broadcast at suitable periods.

In addition to this vastly augmented communication equipment, the Gothic carries the most advanced marine radio aids to navigation. Beneath the keel, the ocean bed is revealed by a Visagraph echometer which draws a continuous contour chart of everything beneath the ship. A Radiolocator traces on a large radar screen every object above the ocean's surface over a circumference of 40 miles, while direction finding equipment will enable the navigator to fix his position on the ocean, up to distances as far as a radio signal can be reliably heard.

Cosmic stopwatch

A COSMIC stopwatch that times events in billionths of a second has been developed by physicists on the Los Angeles campus of the University of California.

One billionth of a second is to a second as one second is to 100 years.

The device will be used to measure the lifetime of certain mesons, particles from atomic nuclei. Such particles are thought to exist for only billionths of a second.

The works of the outsized watch include Geiger tubes, scintillation counters, vacuum tubes and certain germanium elements. It works like this:

Fast-moving cosmic rays from outer space, which bombard the earth constantly, create these mesons when they collide with atoms of matter in the device. These mesons pass through a fluorescent fluid in the instrument, then cease to exist.

Their passage through the fluid causes a brief and feeble flash of light which is picked up by a photomultiplier tube causing it to flash briefly. The time interval between the two flashes is recorded and represents the mesons' brief life span.

Geiger tubes, which detect arrival of cosmic rays, alert the timing mechanism when to start ticking off in billionths of a second. The face of the stopwatch is actually the face of an oscilloscope and is characterised by a series of waves. Wave crests correspond to the numbers of a clock and are two-billionths of a second apart.

Big wheel drives bus

A SPINNING wheel has become the sole power plant in a new Swiss bus that can zoom along silently at a 30-mile-an-hour clip.

The spinning wheel, however, is not the kind great-grandmother used to wind cotton, wool and flaxen fibres into thread, but a 3300lb gyroscope rotor.

Whirling in its hydrogen-filled cage at 3000 revolutions a minute the heavy rotor turns an electric generator that feeds driving motors on the bus wheels. Once brought up to speed, the rotor will revolve for hours, since friction is held to a minimum. But it can power the bus for less than four miles before it has to be "recharged".

To speed the rotor back to a comfortable 3000 rpm. the motorman drives into a recharging station supplied with commercial three-phase 380-volt electric power. He presses a button, and three antenna-like probes rise on the top of the bus to engage the power station's electrical contacts.

In half a minute to three minutes

POPULAR SCIENCE QUIZ

Q. How may scarce water be located in arid regions?

A. According to a geologist of the University of California who has been making a study of the Mojave Desert basin, it may be possible to locate underground water in arid regions through the use of gravimetric measurements, a method with which mineral and petroleum deposits are located.

The mass of a body is a function of its density and, as the gravitational force of the earth depends upon its mass, this force will vary over areas where the density of the earth varies as a result of structural inhomogeneities. With the aid of a sensitive instrument, called the gravimeter, small variations in gravitational force can be measured.

It is this procedure which allows a geologist to locate masses of differing densities and so enables him to determine the underground structure in an effort to pinpoint favorable areas for oil or mineral deposit exploration.

The technique is being used in the study of the Mojave Desert basin. The gravimetric measurements reveal the approximate depths at which bedrock underlies a thick sedimentary deposit of sand and gravel in the desert valley and suggest areas where deep water wells might be drilled.

Q. Has 3-D photographic apparatus been used in cardiography?

A. For more than three years now, medical men in the department of physiology and biophysics at the University of Mississippi have been using apparatus which gives a three-dimensional presentation in the study of the human heart. It is called the stereovectorcardiograph.

Use of the electrocardiograph with presentation in two dimensions only has been common for a number of years but the making of three-dimensional vectorcardiograms is something new.

The particular apparatus designed in the laboratory of the University of Mississippi uses a split-beam 5in cathode ray tube. One of the beams records on the left-hand side of the screen and the other on the right-hand side. The operation of the equipment is so simplified that clinicians can produce 3-D vectorcardiograms almost as easily as they now make recordings on a single plane.

The three-dimensional effect can be obtained by direct observation from the screen of the cathode ray tube or by photographing the images first. Using an appropriate camera, positive prints can be produced in about one minute.

Q. How close to the earth are some planets predicted to pass?

A. It is predicted that in the year 1968 the planet Icarus will come within about 4-million miles of the earth. Astronomically speaking, this is a relatively close passage, being about four times closer than any minor planet has yet been predicted to come. This asteroid may well serve as the most critical astronomical test of Professor Einstein's theory of relativity.

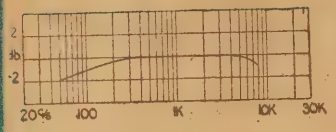
Icarus, the most eccentric object known in the solar system, travels closer to the sun than any other object. It is the only body outside of a comet known to pass within the orbit of Mercury. Most other asteroids are confined to a zone between the orbits of Mars and Jupiter.

The planet has a diameter which is the smallest yet calculated, about half a mile. Because it can approach as close as 17-million miles to the sun, it is named after the mythological boy whose wax-attached wings melted off in a flight too close to the sun.

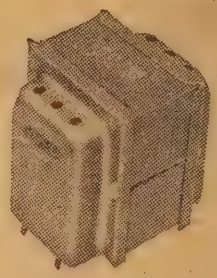
FERGUSON — FOR ALL YOUR AUDIO OUTPUT TRANSFORMER REQUIREMENTS

PUBLIC ADDRESS RANGE
50-8000 C/S ± 2 dB

This range is designed for use with public address systems, factory music while you work, etc. A small section of our extensive range is presented below.

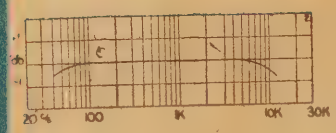


Code No.	Watts	PRIM Z.	SEC. Z.
OP-1	10	5000, 2500 SE	12.5, 8, 2.3
OP-1A	10	5000, 2500 SE	500
OP-2	15	5000 PP	12.5, 8, 2.3
OP-3	15	6600 PP	12.5, 8, 2.3
OP-4	15	10000 PP	12.5, 8, 2.3
OP-11	25	6600 PP	500, 250, 125
OP-12	25	10000 PP	500, 250, 125
OP-15	32	6600 PP	500, 250, 125
OP-16	32	10000 PP	500, 250, 125
OP-37	80	6400 PP	500, 250, 125

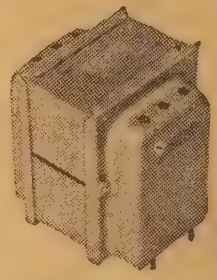


MEDIUM FIDELITY RANGE
40-12000 C/S ± 1 dB

This range has been especially designed for use with the Rola 12-OX speaker. These transformers are especially suitable for use with triodes.

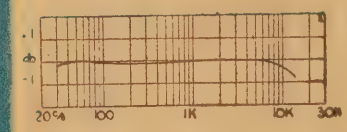


Code No.	Watts	PRIM. Z.	SEC. Z.
OP-112	6	10000 PP	2
OP-113	6	5000 SE	2
OP-117	6	5000 PP	2
OP-118	6	8000 PP	2
OP-119	6	6600 PP	2
OP-183	6	7000 SE	15, 2

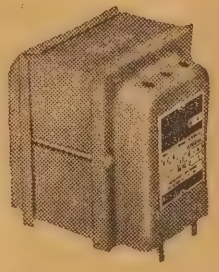


HIGH FIDELITY RANGE
30-15000 C/S ± 1 dB

These transformers are primarily for use with Goodman and other extended frequency response speakers. Section below is only small part of our range.

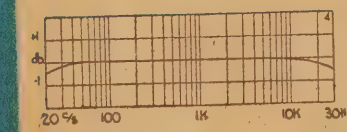


Code No.	Watts	PRIM. Z.	SEC. Z.
OP-22	10	3250 SE	500, 25, 2.3
OP-23	10	3250 SE	12.5, 8, 4, 2.1
OP-19A	15	5000 PP	12.5 8. 2.3
OP-19B	15	5000 PP	500, 250, 125
OP-21	15	8000 PP	500, 250, 125
OP-62	15	10000 PP	500, 125
OP-63	15	10000 PP	15, 3.75
OP-64	15	10000 PP	12.5, 3.125
OP-65	15	10000 PP	8.4, 2.1
OP-51	20	4500 PP	15.5, 12.5, 8.6, 2.8, 2

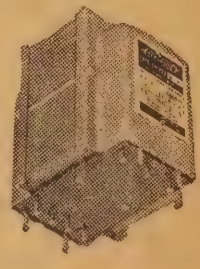


SPECIAL HI-FI RANGE
20-30000 C/S ± 0.5 dB

These transformers are for use in the Williamson Amplifier, and fulfil every requirement specified by D. N. T. Williamson.



Code No.	Watts	PRIM. Z.	SEC. Z
OP25/500	15	10000 PP	500, 125
OP25/250	15	10000 PP	250, 62.5
OP25/40	15	10000 PP	40, 10
OP25/16	15	10000 PP	16, 4
OP25/15	15	10000 PP	15, 3.75
OP25/12	15	10000 PP	12, 3
OP25/10	15	10000 PP	10, 2.5
OP25/8.4	15	10000 PP	8.4, 2.1
OP-66	15	5000 PP	8.4, 3.7
OP-67	15	5000 PP	15, 6.5



Ferguson Transformers Pty. Ltd., Ferguson Lane Chatswood—Phone JA2878. Available from retailers in every State.

the flywheel again is spinning fast enough to power the bus another 3½ miles at 30 miles an hour.

Built by the Oerlikon Engineering Co. in Zurich, the 50-passenger bus requires no rails or trolley wires, making its initial cost relatively low. "Recharging" stations are inexpensive to build and require little equipment. Passengers enthusiastically report the bus provides a vibrationless, noiseless, odorless ride.

Those wiggly planes

A PECULIAR wiggly motion of aeroplanes has been traced to fuel sloshing in the fuel tank.

Wiggly planes have bothered pilots for years. Although their noses may be pointed straight ahead, planes often weave sidewise and occasionally up and down, even in calm air.

With the cruising and fighting speeds of jet planes being pushed ever higher, this wiggly motion has become more dangerous.

Planes have a tendency to wiggle from side to side anyway, reports Albert A. Schy, of NACA's Langley Field Aeronautical Laboratories. This tendency is called the natural plane frequency. It compares to the back-and-forth motion of the balance wheel in your wrist watch.

If something "kicks" the plane just at the right instant and in the right direction—the way your watch spring "kicks" the balance wheel through a complex train of gears—the wiggly motion of the plane becomes even more pronounced. Gas slopping from side to side in the fuel tank can provide the "kicks".

Jet planes, which generally carry more fuel than piston-engined craft, thus are more affected by sloshing fuel because of the greater weight being thrown about in the fuel tanks. In aerial combat, where manoeuvrability is at a premium, this "snaking" motion is a handicap.

Sloshing fuel can be controlled by baffles installed in the fuel tanks. The baffles disrupt the normal sloshing movements of the fuel so the fuel "kicks" are much weaker and come at the wrong time. This sets up turbulence in the fuel that helps to dampen the normal weaving of the plane.

Robot production

UNTOUCHED by human hand—almost can be applied to powerful aircraft engines now being turned out in the US.

The Curtis-Wright Corporation is now producing engines from what it claims to be the first automatic aircraft engine production line in history.

The production line includes automatic machines that do everything from assembling a complete crankshaft to tightening bolts and crimping fasteners.

The previous production line was simply a floor conveyor taking engines on stands past 25 human assembly stations on a pre-determined time cycle.

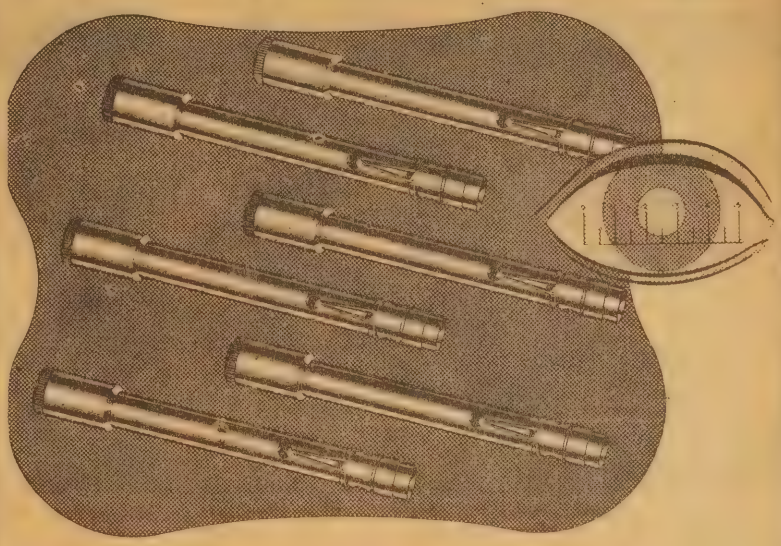
The new line can increase output by 250 pc, but occupies 42 pc less space than the old.

Some of its automatic equipment does work five times faster than the best human operator.

One machine on the line automatically locks in place the valve springs in every cylinder.

Seconds later it pushes down the valve spring again so that the rocker arm can be dropped into place.

PERSONAL PROTECTION



THE KERSHAW POCKET DOSIMETER

Workers in the nuclear physics and radiography fields cannot afford to be without some form of radiation monitor to determine the total dosage received over any period.

The Kershaw Pocket Dosimeter is the ideal unit — a personal monitor for indicating the integrated doses of Gamma and Hard X-ray radiation received by an individual over any period.

In the shape of a fountain pen measuring less than five inches in length, it is conveniently clipped in the pocket. To determine the accumulated radiation exposure the Dosimeter is held toward a light source and an integral graticule, calibrated to a maximum of 500 milliroentgens, accurately indicates the total dose. A quartz fibre, which moves across the graticule in response to the dose received, is reset to zero by a charging unit.

A direct reading of Exposure is available. It is, therefore, vastly superior to the film-badge type monitor.

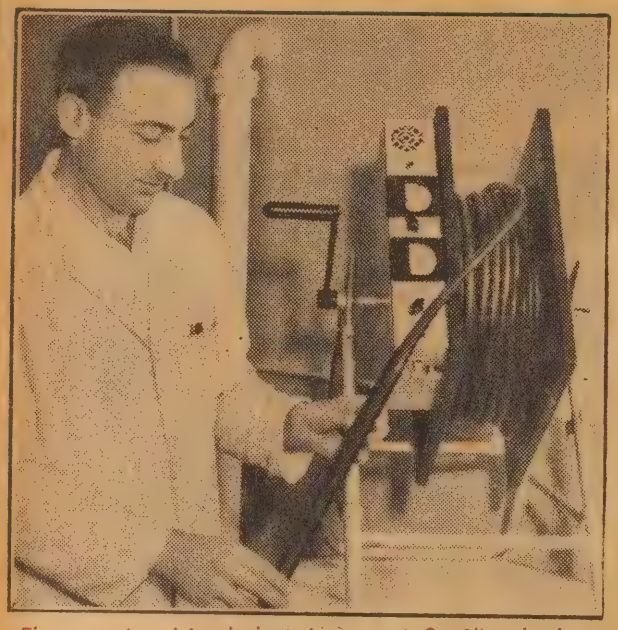
THE CINTEL PORTABLE RATEMETER

For location and rough assaying of radio-active elements and minerals that emit gamma-rays, the Cintel Portable Ratemeter consists of a probe unit carried in the hand, and a Battery and Meter Unit, worn on the operator's chest, and provided with three ranges giving full scale values of 80, 400 and 2,000 counts per min. Earphones are provided, thus avoiding the necessity of continuous observation of the meter.

For full particulars contact Test Instruments Dept.

AMALGAMATED WIRELESS (Australasia) LTD.

167 Queen St., MELBOURNE, MU9169. 47 York St., SYDNEY, BO233.
Lambton Quay, WELLINGTON, N.Z., Phone 45-076.



The apparatus pictured above is a recent Canadian development of an underground Geiger counter used for probing diamond drill holes up to 1000 feet in depth for uranium deposits.

This uranium prospector makes use of a portable Geiger counter to check a rock formation for evidence of radio-activity. These portable instruments vary a good deal in size and shape.

GEIGER COUNTERS FIND URANIUM

The reference "Geiger-Muller" is fast achieving a familiar ring to the man in the street because of its association with such terms as "uranium" and "radio-activity". In this article, we explain this association together with the general design and operation of the Geiger counter as a complete instrument.

by Raymond Howe

MORE than once since World War II, Australia has sprung into world newspaper headlines with news of important geological discoveries.

Most recent is the location of possible oil-bearing strata and which, for a time, turned stock exchanges into bedlam. Although, to date, no really productive oil wells are operating here, the progress so far has intensified the search both in Australia and New Guinea.

Of equal, if not greater, moment, is the discovery of worthwhile fields of uranium-bearing mineral ore. In this postwar atomic age, such discoveries are of great national and economic importance.

ATOMIC ENERGY

No one is prepared to deny that as each decade passes, atomic energy will play a progressively greater part in our daily life. Today, on the defence front, one milestone has been passed with the launching of an atomic-powered submarine.

In the future, it could well be that a nation's wealth will be measured in terms of its production of uranium and other radio-active minerals, in the same way as oil influenced a nation's income from about the turn of the century.

It is obvious then why the Government is intensely interested in present and future activities in any prospecting, both for oil and uranium-bearing ores.

As an indication of the Government's interest, the Minister for Supply and Development is empowered to grant rewards to persons who discover new deposits of uranium-bearing mineral ore.

For instance, where a deposit is considered to be of economic importance, a reward of up to £1000 may be paid. If a deposit is considered as being capable of producing 25 tons, or more, of uranium oxide, a reward may be approved for £1000 plus £2000 for each 25 tons of uranium oxide recovered from the deposit.

Two limitations are that the maximum amount of any reward is set at £25,000 and that any new deposit should be at least 15 miles from any other deposit, the existence of which is recorded in a list kept by the Secretary of the department.

It can be seen, then, that a sizable reward awaits any person who is fortunate enough to locate one or more worthwhile deposits of uranium-bearing minerals.

As will be explained in due course, the construction of apparatus suitable for the detection of radio-active minerals is not beyond the scope of the home constructor and does not necessarily involve excessive expenditure.

PROSPECTING

Prospecting can be carried out at odd times while away on vacation or during trips into the country. The budding prospector should, of course, become familiar with the appearance of the various uranium-bearing minerals. A browse through an appropriate text-book on geology plus a visit to a museum can be of assistance in this respect.

At this stage, you may well ask what is "radio-activity". A mineral, or any substance for that matter, is said to be radio-

active if it emits radiations without assistance from any outside source. Such minerals as uranium and thorium fall into this category.

As a result of this radiation, the original radio-active substance breaks up into different elements. For uranium, the process goes through various stages of uranium of decreasing atomic weight to ionium, thence to radium and through its various states down to polonium and finally ends up as radium lead.

Some of the stages have a very short half-life, some being measured in days or even hours or minutes, others in years. The complete process is very slow however, as far as our concept of time is concerned, running into some thousands of millions of years.

The history of uranium goes back to 1789 when it was discovered by a German scientist called Klaproth who gave the mineral its present name after the planet Uranus. In 1896 Becquerel noticed that rays emitted by compounds of uranium gave an impression on a photographic plate.

Later, in 1902 M. and Mme Curie isolated a substance from uranium which proved to be more radio-active than the parent mineral. It was subsequently called radium, a term with which most of us are familiar.

URANINITE

Uranium is present in quite a number of minerals, but the most important one, in terms of current commercial yield, is uraninite. The term "pitchblende" is usually given to varieties of uraninite which do not show the characteristic crystalline structure.

The radiations emitted by uranium and similar radio-active substances are of three different types. These are called alpha rays, beta rays and gamma rays.

The alpha rays are actually positively-charged particles projected from the atom of uranium or similar substance. They travel at about 10 pc of the velocity of light, but have a range of only five to six centimetres in air.

They can be absorbed by metallic shields, they can affect a photographic plate, will ionise the air through which they pass and can cause certain bodies to fluoresce. They can be deflected by an electric or a magnetic field.

The beta rays are negatively-charged particles of smaller mass than the alpha particle. However, because their velocity is very close to that of light, they are more penetrating, to an extent of about 100 times that of an alpha particle.

They suffer greater deflection from an electric or magnetic field, but cause less ionisation and have less effect photographically than an alpha particle.

To the prospector, the gamma ray is the most important. They are of an entirely different nature from the two preceding ray types. Actually, they are bursts of electro-magnetic radiation similar to x-rays and light rays.

As such, they are very penetrating. Under certain conditions, they may be detectable through some 30 feet of soil. On the other hand, certain types of soil covering a deposit can limit their penetration to about three feet.

DETECTION METHODS

Our interest lies in the detection of these rays, the gamma rays in particular. There are various methods of achieving this. We have already inferred one method, that of activating a photographic plate.

The mineral sample to be tested is placed on a photographic film or plate, which has been suitably covered to prevent exposure to light. A metallic object, such as a coin, is placed between the sample and the film. After a lengthy exposure time any radio-activity exhibited by the sample will cause a silhouette of the metallic object to appear upon the developed film.

Exposure time naturally depends upon the grade of the radio-active ore and the type of photographic paper. At one end of the scale, high-grade ore and fast panchromatic paper may give a useful indication within 12 hours, while low-grade ore and slower paper may require from one week to a month. Either way, the limitations of the method are obvious.

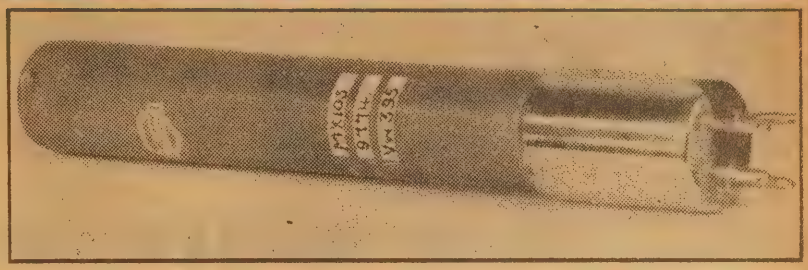
Another direct test for radio-activity is the "Mineralight". This lamp emits invisible ultra-violet light, which, when directed at some radio-active specimens, causes them to fluoresce. Commercial units of this type normally operate from 240-volt power mains.

The use of the lamp is limited because only a few of the secondary uranium-bearing ores will react, although non-fluorescing minerals can be detected by fusing small quantities with sodium fluoride or borax to form a bead. Generally speaking, its power mains requirement plus the necessity to use it in the dark limit the "Mineralight's" use in the field.

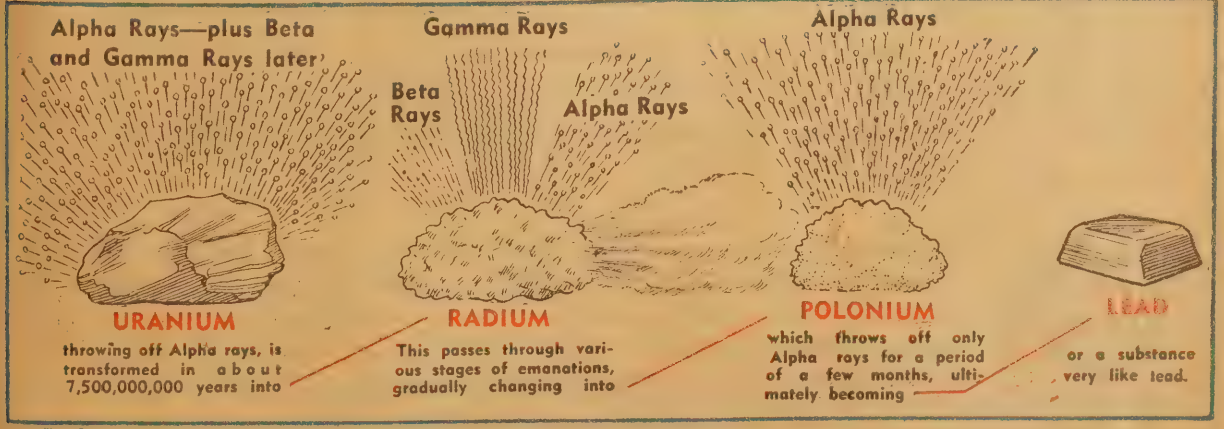
ELECTROSCOPE

The familiar high school physics electroscope is capable of indicating radio-activity in a mineral specimen. The electroscope is charged in the usual way and the specimen is placed within an inch or so of the leaves. Any radio-activity will ionise

A TYPICAL GEIGER-MULLER TUBE



This is one type of gamma-counting Geiger tube which is available in Australia. It is about 1in in diameter and about 7½in long. Another locally-available type measures about 7/8in diameter by about 5¾in long and operates at just over 1000 volts.


Alpha Rays—plus Beta and Gamma Rays later
URANIUM
throwing off Alpha rays, is transformed in about 7,500,000,000 years into
Gamma Rays
Beta Rays
Alpha Rays
RADIUM
This passes through various stages of emanations, gradually changing into
Alpha Rays
POLONIUM
which throws off only Alpha rays for a period of a few months, ultimately becoming
LEAD
or a substance very like lead.

This diagram taken from an earlier issue shows radio-active decomposition in a very much simplified form. It must be appreciated that the terms given are broadly descriptive. For instance, there is no gamma radiation from radium, only from its active deposits.

Mullard

GEIGER COUNTER TUBES

The range of Mullard Geiger Counter Tubes includes types for the detection of Gamma adiation and Alpha and Beta particles and photons down to very low energies. All ypes are halogen quenched having a long life, and operating over a wide temperature ange. Of special note is the MX103, a low voltage, all metal, self-quenched gamma counter suited for portable radiation detectors and which along with the other types was developed in collaboration with the Atomic Energy Research Establishment, Harwell.

ype	Application	Overall Length	Overall Diameter	Threshold Voltage (max) at 20oC	Plateau Length (min.) at 20oC	Plateau Slope %per 100V (average)	Operating Temperature Range	Unshielded Background Counts/ min. (max)	Background Counts/ min. Shielded 2 in Pb ¼ in Al	Window Thick-ness. mg/cm2.	Dead Time US approx.
MX103	Gamma Counter	195mm	29mm	370V	100V	8%	-55 to + 75°C	110		375	130
MX108	Beta/Gamma Counter	110mm	26mm	370V	100V	8%	" " "	45	20	10	100
MX113	Alpha/Beta Counter	85.7mm	14.2mm	575V	150V	6%	" " "		6	1.6 to 2.1	50
MX114	Beta Counter	95mm	33.3mm	600V	200V	6%	" " "		40	3.5 to 4.0	150
MX115	Gamma Counter	110mm	26mm	370V	100V	8%	" " "	45	20	375	100
MX118	X-Radiation Counter	168mm	26mm	1140V	200V	5%	" " "		50	3.5 to 4.0	150
MX122	X-Radiation Counter	168mm	26mm	940V	200V	5%	+10 to + 75°C		50	3.5 to 4.0	350

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Radio Receiving and Transmitting Valves—Television Picture Tubes—Electronic Photo-flash Tubes—Hearing Aid Valves—X-ray Tubes and Accessories—Geiger Counter Tubes—Cathode Ray Tubes—Photo Cells—Image Converters—Industrial Power Valves and Rectifiers—Thyratrons—Stabilising and Voltage Reference Tubes—Electrometers—Cold Cathode Tubes—Measuring Instruments—Scientific Apparatus—Radio Receivers—Communications Equipment—Ultrasonic Generators—Permanent Magnets, etc.

the air between leaves, causing the accumulated charge to leak away.

With experience, the rate of collapse of the leaves through a selected distance will give an indication of the degree of radio-activity. The instrument is not suited for portable use, however.

A scintillation test can also be applied to detect radio-activity. It functions on the fact that, if zinc sulphide is struck with a ray from a radio-active mineral, it will emit minute flashes called "scintillations". Other phosphors also have been used successfully.

In its basic form, this test must be applied in the dark. However, commercial units are available, at a price, which use photomultiplier tubes to detect the flashes and pass them on to electronic circuits which ultimately record them as a reading on a meter. This type can be used in daylight.

Probably the most useful and convenient instrument for detection of radio-activity in the field is the Geiger-Muller counter, or simply the Geiger counter.

It can be adapted extremely well to portable use, is relatively rugged and is reasonably reliable when backed with a little commonsense, born of experience.

As this is the instrument in which we are really interested, we intend devoting some time to discussing its operation and the associated circuitry.

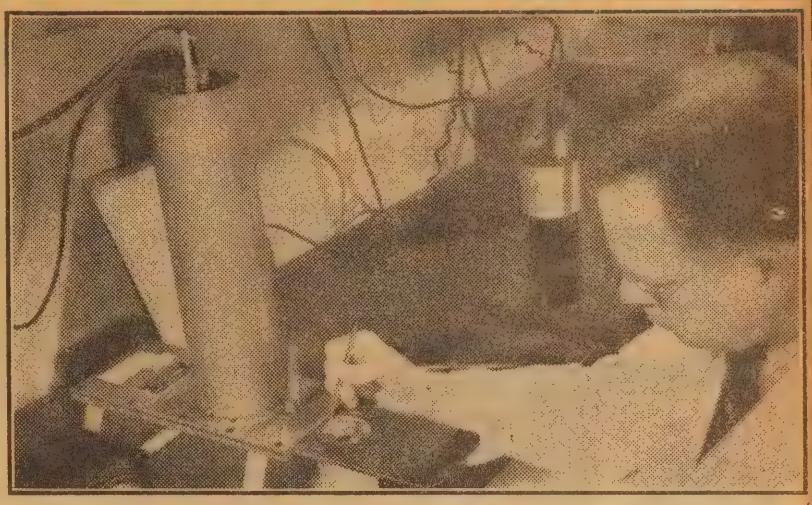
GEIGER TUBE

The heart of the Geiger counter is the Geiger counter tube. This is simply a two-element gas-filled chamber having an anode and a cathode.

The cathode is formed by the outside metal tube, while the anode consists of a thin wire running down the centre. The metal tube is evacuated, filled with a suitable type of gas and sealed. The types in which we are most likely to be interested are filled with argon or neon.

The anode of the tube is held at a relatively high positive potential. A year or two ago, prospecting types of Geiger tubes required something like 1000 volts between the electrodes. Types recently developed require only 400-odd volts across them.

LABORATORY TEST FOR SAMPLES



A laboratory-type scintillation counter as used to measure radio-activity in a variety of substances. Here the operator is determining radio-activity of haemoglobin prepared from blood of animals 72 hours after they have been injected with a solution of iron and subjected to mild radiation. It is connected with the study of the effects of radiation on red blood cells.

When a radio-active particle or pulse enters the tube, it breaks up some gas molecules into positive-charged ions and free electrons.

By reason of their polarity, the ions drift toward the negative cathode where they recombine with electrons to find equilibrium. The electrons are attracted toward the positive-charged anode and, in so doing, constitute a brief current flow through the tube.

If we insert a resistor in series with the supply to the electrodes, the minute burst of current will produce a change in voltage of short duration at the anode. When amplified, this pulse can be heard in a pair of headphones.

PULSE/VOLTAGE CURVE

The actual potential across the Geiger tube sets the mode of operation. At low voltages, only the relatively large mass of the alpha particle is capable of producing an ionisation of the gas in the tube.

The lighter beta particle and the important gamma ray are unlikely to dislodge sufficient electrons to register a pulse. This portion of the pulse/voltage curve, of the Geiger tube is termed the "ionisation chamber region" and is a relatively insensitive region.

At increased voltage, the velocity of electrons dislodged by the ray is sufficient to ionise other gas molecules and the number of electrons attracted to the anode is a simple multiple of those released initially. This portion of the Geiger tube curve is called the "proportional counting" region and is also relatively insensitive.

Further increase of voltage places the gas atoms in such a state of stress that a single ray collision is sufficient to set off a whole chain of collisions which can produce audible pulses from the tube. In this state alpha and beta particles as well as gamma rays are all capable of producing ionisation.

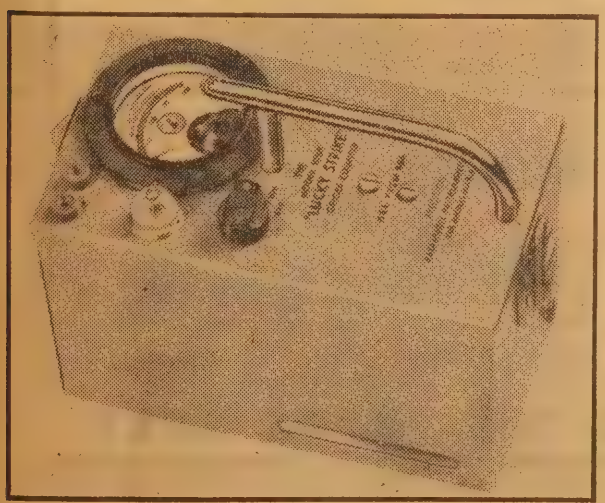
This is the condition of greatest sensitivity for the Geiger tube and this portion of the Geiger tube curve is therefore called the "Geiger region".

The range of voltage over which this desired Geiger action takes place is also called the "plateau". Taking the voltage beyond this range will simply cause the tube to ionise and conduct continuously. The point at which this occurs is called the "striking voltage".

TUBE QUENCHING

There is yet one more important point. Many of us are aware from experience with neon tube oscillators and gas-discharge time-base tubes that, once ionisation is produced, it can be extinguished only by reducing the electrode potential to a considerably lower level.

With the Geiger tube, this can be done with fairly simple circuitry and, as a matter of fact, was done with tubes types of the past. However, modern tubes are of the "self-



★

This a typical portable Geiger counter of American design. Methods of indicating radio-activity are by headphones, neon flasher or direct-reading meter. Batteries consist of two torch cells, two miniature 45 volt batteries and one 22.5 volt miniature hearing-aid battery.

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quenching" type. That is, they are capable of quenching the ionisation without external assistance. This is achieved by adding a small percentage of a more complex gas to the chamber.

Once the tube has been ionised, it takes a finite time for the tube to recover and be ready for the next period of ionisation. During this period, the tube is completely insensitive to radio-active rays and hence, this is called "dead time". In the tube types with which we are concerned, the dead time is around one ten-thousandth of a second.

Various gases may be used to produce the self-quenching action but as they affect the characteristics of the Geiger tube in different ways, some gas admixtures are preferable to others. As a matter of fact, they so link up with other problems, that the tube design has to be viewed as a whole.

To meet the different requirements of various applications, it is necessary to consider the dimensions of the tube, the composition of the gas filling, the materials for the anode wire and the outer tube and the composition and thickness of the window (if used).

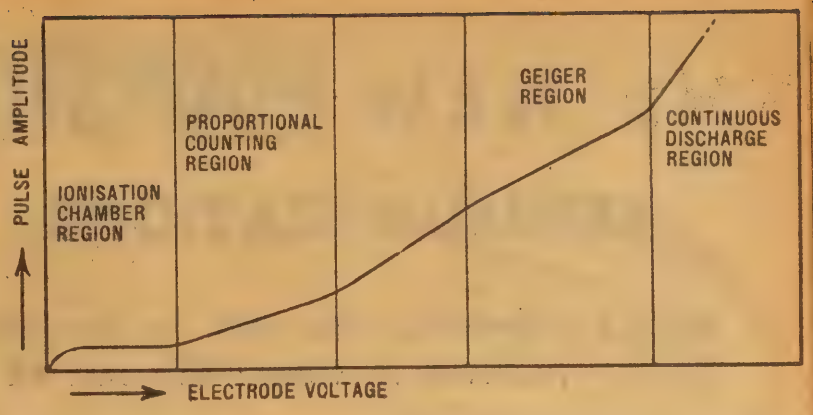
TUBE DESIGN

These factors, in turn, affect the operating voltage, the volume efficiency, the constancy of operation and the life of the tube.

Geiger tubes are designed for counting alpha rays only, beta and gamma rays, or gamma rays only. Alpha rays are generally associated with laboratory work and do not normally come into the field of prospecting.

Tubes for counting beta rays are provided with either a glass or mica window in the side or at one end. The window material is within a certain range of thickness to avoid undue absorption of the beta rays.

Because gamma rays will pass through the metal tube of a Geiger counter, a "windowed" Geiger tube will count both beta and gamma rays. If detection of beta ray activity only is desired, a count is taken with the window covered by a metallic cap and again with the window uncovered. The difference in count is due to the beta rays.



This curve relates a Geiger tube pulse amplitude to its electrode voltage. In the "Geiger region" the pulse amplitude rises with applied voltage but the number of counts per minute increases by less than 10pc.

A gamma ray tube is simply a metal cylinder containing the anode wire and argon or neon gas. This is the type of tube which most prospectors will encounter. The connections are brought out through pins at one end so that it can plug into a socket in the same way as a radio tube.

The sensitivity of a Geiger tube depends upon the amount of "active" surface area and the pressure of the enclosed gas, but so also does the operating voltage. Hence tubes for prospecting and those for industrial tracing, laboratory and medical work will have different characteristics.

BACKGROUND COUNT

It should be appreciated that a Geiger tube is also capable of indicating the presence of cosmic radiation from outer space. As a matter of fact, cosmic radiation produces in every Geiger counter what is called the "background count".

In a particular type of tube which is available locally, the "background count" is about 75 per minute. To give you an idea of the penetrating ability of cosmic radiation, shielding of the tube with a 2-inch thickness of lead plus a ½-inch thickness of aluminium reduces the background count to about only 40 counts per minute.

This background count is quite spasmodic. Except in special laboratory applications, no steps are taken to reduce it, because when the Geiger counter is brought within the vicinity of any radio-activity worthwhile from the prospecting angle, the change in the rate of count and the tendency toward regularity is sufficiently well marked as not to cause any confusion.

One advantage of the background count is that it serves as a convenient means of adjusting initially the Geiger tube operating voltage. It is also an indication that the instrument is functioning satisfactorily.

In the normal way, the Geiger tube voltage control is advanced until the background count is heard and taken still further until the background count ceases. The control is then set somewhere within this range, preferably toward the high voltage end.

So much for the Geiger tube itself. Before discussing the associated circuitry, we might well attempt to establish a rough mental picture of what a portable Geiger counter looks like.

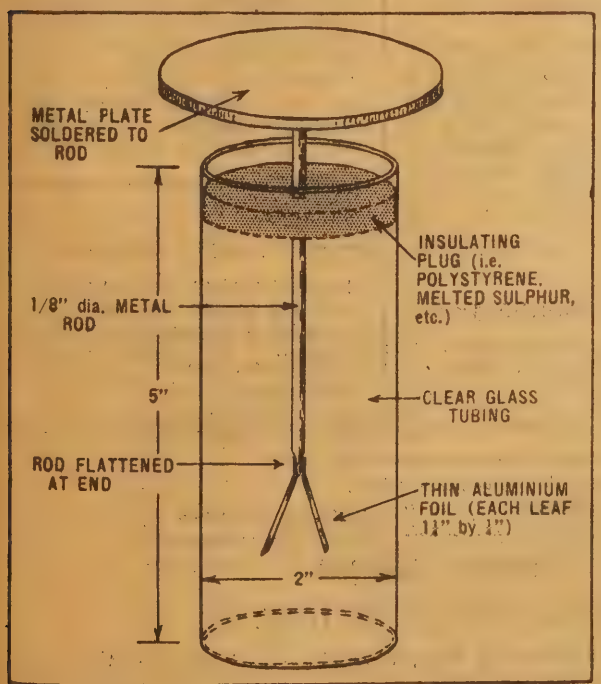
THREE GROUPS

The general trend in the overseas commercial field seems to divide into three distinct groups. One group is represented by a small hand-carried unit containing all components, including batteries and Geiger tube. In use, the unit itself is passed over the area being investigated for radio-activity.

A second group has larger overall dimensions and is carried either by hand or by a shoulder strap. The Geiger tube is contained in a metal sleeve and connections made to the main unit through a flexible cable. Counting is registered by phones, by neon flasher and/or an integrating meter.

The third group could be considered as an elaboration of the second group carrying additional features which account for larger size and increased weight. In the main, these more elaborate units could be used in the laboratory as well as in the field.

Coming now to the design of the associated circuitry, provision of the operating voltage for the Geiger tube deserves first consideration.


METAL PLATE SOLDERED TO ROD
INSULATING PLUG (i.e. POLYSTYRENE. MELTED SULPHUR, etc.)
1/8" dia. METAL ROD
5"
CLEAR GLASS TUBING
ROD FLATTENED AT END
THIN ALUMINIUM FOIL (EACH LEAF 1¼" by 1")
2"

★

Here is an electroscope which could be made from scrap material. The aluminium foil, obtainable from art supply stores, should be sufficiently thin to allow objects to be distinguished through it.

THE NEW EDDYSTONE "840"

COMMUNICATIONS RECEIVER

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The Eddystone "840" communications receiver is an A.C./D.C. model, having a continuous coverage from 30 Mc/s. (10 metres) to 480 kc/s. (620 metres), and is recommended for professional or amateur use. The receiver is a sound engineering product, designed to give the highest efficiency. The signal-to-noise ratio, sensitivity, selectivity and other technical characteristics are excellent and a good all-round performance is obtainable.

The tuning mechanism, which is gear-driven and flywheel loaded, gives a silky yet wholly positive control. A reasonable degree of bandspread is provided by the auxiliary scale, visible in the top right-hand corner of the main dial. In effect, it opens out each range to a length equivalent to sixty inches and is invaluable for logging purposes.

Materials of the highest quality are used throughout, construction is extremely robust, and the worksmanship is unexcelled. The "840" operates equally well from A.C. or D.C. mains, a selector being provided for inputs of 100/110 and 220/250 volts. The insulation between the metal cabinet and the interior has received special attention and is more than adequate.

CIRCUIT

The receiver is a seven valve superheterodyne as follows :

V1	UAF42	RF Amplifier
V2	UCH42	Frequency Changer.
V3	UAF42	IF Amplifier and AGC
V4	UAF42	AF Amplifier and Detector.
V5	UL41	Output.
V6	UAF42	Beat Frequency Oscillator.
V7	UY41	Rectifier.

All valves have B8A bases.

TECHNICAL PERFORMANCE

Sensitivity is better than 10 microvolts for a 15 db signal-to-noise ratio. Selectivity 30 db down 10 kc/s. off resonance. Image ratio better than 15 db at 30 Mc/s. and correspondingly higher at lower frequencies. Undistorted audio output .75 watts. Maximum output exceeds 1.2 watts.

LOUDSPEAKER

A high-flux loudspeaker is fitted internally, the connections being brought out to the rear to permit an easy changeover to an external speaker when desired. The latter should have an impedance of 2.5 ohms, the Eddystone No. 688 being recommended. On the front panel is a jack to take high resistance telephones, the insertion of which automatically mutes the speaker.

TUNING RANGE

Range 1 30.6 Mc/s. to 10.5 Mc/s.
Range 2 10.6 Mc/s. to 3.7 Mc/s.
Range 3 3.8 Mc/s. to 1.4 Mc/s.
Range 4 205 Metres to 620 Metres.

The first three ranges are directly calibrated in frequency and the fourth in wavelength, to an accuracy of better than 0.5%. Range 4 includes the International Distress frequency.

TUNING MECHANISM

The tuning is controlled by a gear-driven, flywheel-loaded mechanism, having a reduction ratio of approximately 140 to 1. It is smooth, positive and free from backlash. In the top right-hand opening is an auxiliary band-spread scale which gives an equivalent of 60 inches per range and permits accurate re-setting.

AUTOMATIC GAIN CONTROL

The delayed AGC system maintains the output within 25 db for a change in input of 80 db above 3 microvolts. AGC is switched off when the BFO is brought into use.

WEIGHT AND DIMENSIONS

The weight is 30lbs. The dimensions are : Overall width 16¾" ; Depth, 10½" ; Height, 8¾".

POWER SUPPLY

Inputs of 100/115 volts and 220/250 volts are catered for, and current consumption is approximately 0.275 amperes. The receiver operates equally well from D.C. mains or A.C. (25/60 cycles) mains.

BEAT FREQUENCY OSCILLATOR—Gives a variation of plus or minus 3 kc/s.
NOISE LIMITER—Optional by front panel switch. Effective against ignition and similar noise.

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Power supply design introduces the question of permissible weight of the complete instrument. It does, in fact, affect the general physical design of the counter, and ideas will vary according to the factors involved in individual cases.

One person may want a light dry-battery operated instrument which can be put aside for a month or so until the next occasion to use it arises. Another may favor a heavier instrument with additional features for which he is prepared to replace batteries at regular intervals or periodically charge a small portable accumulator. The latter case would fit in with a concentrated program of prospecting over a selected area.

For the present, we will simply discuss the relative merits of different types of power supplies so that individuals may weigh the factors involved in the light of their own requirements.

BATTERY OPERATION

Complete dry-battery operation need hardly be considered because suitable high-voltage batteries are not available in this country. Some overseas commercial units use high-voltage batteries ranging from a single 300-volt unit to three in series.

In view of the extremely light current drain, the batteries could be expected to give their shelf life, but the replacement cost has proved a deterrent to wholesale adoption of the idea.

Enough standard batteries to give say 400 volts would be heavy as well as costly. Thus, six 67.5 volt miniature batteries would weigh over 4 pounds and cost nearly £6. Four 90 volt and one 67.5 volt miniature batteries would weigh just under 5 pounds and cost about the same.

The latter combination would also require a potentiometer across one of the batteries to set the operating voltage for the Geiger tube though it has the advantage of being able to run the batteries to their "last gasp".

In each case, portion of the battery bank could be used to operate the pulse amplifier. The added drain on this section would necessitate more regular replacement or an interchange of batteries.

CAPACITOR SWITCHING

A simple method which has been used successfully in some overseas commercial units consists of a switching arrangement which puts several capacitors across a single HT battery, then arranges them in series to produce a total voltage several times that of the internal battery.

Since the current drain through the Geiger tube may be only 1 to 2 microamperes, several minutes of operation can be obtained from one charge into good quality capacitors. Loss of adequate charge is indicated by disappearance of the background count.

The operator then merely has to flick the switch to the "charge" position, pause, flick it back to the "operate" position and the instrument is ready for another period of counting.

Vibrator supplies have been used in some commercial models, but they have their problems. Though the load current of the Geiger tube on the vibrator transformer secondary winding is insignificant, there is a minimum battery drain below which it is difficult to go. This is made up by the current for the reed driving coil and that due to transformer losses.

The high tension battery can be dispensed with by feeding the counting pulse amplifier through a dropping resistor from the Geiger tube supply voltage, but the energy dissipated in the resistor is wasted.

Nevertheless, on this basis, the instrument could be operated probably at a drain of about 1 ampere from a 6-volt battery bank or a small rechargeable accumulator.

The feasibility of carrying a small accumulator — and there are some small types available at the present time—would have to be considered by the individual. The dry battery used in an electric lantern may also be worth some thought.

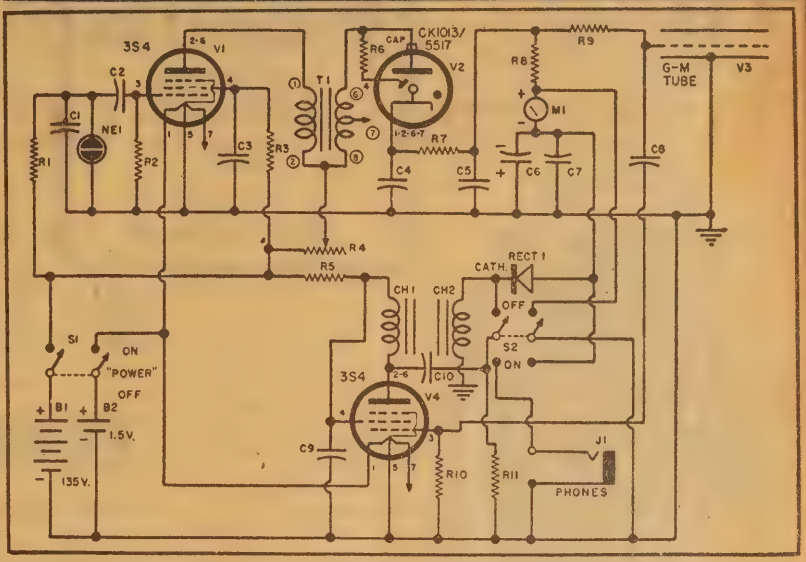
An RF power supply as used for a CR tube is a further possibility. Although we know of no special RF transformers on the market at present, the type used for CRT supplies may be suitable, when used with a miniature battery valve.

Battery supply for both filament and high tension to the RF oscillator and the counting pulse amplifier would be required, but the drain should be below that for a small personal portable radio.

A high voltage rectifier would be necessary, but this need not present any great difficulty. A selenium dry rectifier as used in electronic photo-

(Continued on Page 109)

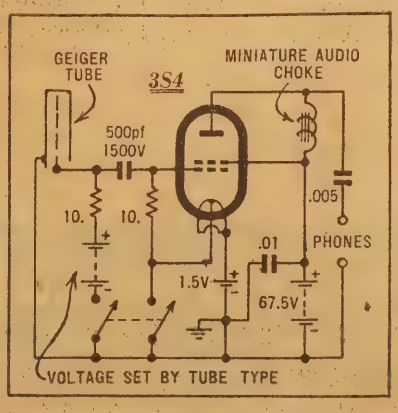
TYPICAL DESIGN FROM OVERSEAS



This circuit diagram of a Geiger counter illustrates the neon tube power supply as discussed in the text. Radio-activity indication is by phones or meter.

PARTS LIST

R1 6.8 meg. ½w.
R2 22 meg. ½w.
R3 .047 meg. ½w.
R4 .05 meg. pot.
R5 .1 meg. ½w.
R6, R9, R10 10 meg. ½w.
R7 .47 meg. ½w.
R8 30 meg. ½w. (no. of res. in series)
R11 1 meg. ½w.
C1 400 pf mica
C2 .001 pf mica
C3 .002 pf mica
C4 .002 pf 2000V
C5 .05 pf 2000V
C6, C7 500 pf 12V electro
C8 500 pf 2000V
C9 .01 pf 400V
C10 .005 pf mica
S1 D.p.s.t. toggle sw.
S2 D.p.d.t. toggle sw.
T1 Interstage trans
CH1, CH2 reactor
M1 0-100 microammeter
J1 Midget open circuit phone jack
Rect .1 1N34 crystal diode
NE1 neon lamp
B1 Two 67½V "B" batteries
B2 Three 1½V standard flashlight cells
V1, V4 3S4
V2 CK1013/5517
V3 Type 1B85 or equiv.



A simple circuit showing the pulse amplifier and battery supply to the Geiger tube.

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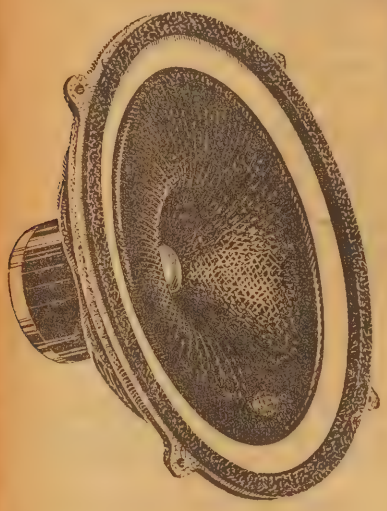

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FUNDAMENTAL RESONANCE ... ... (APPROX.) 35 C.P.S.
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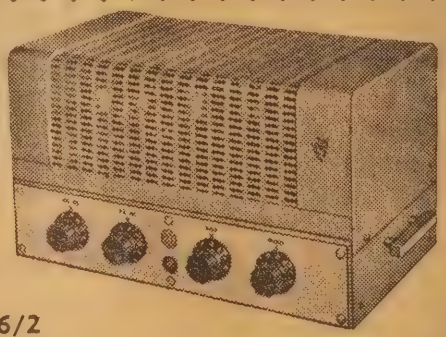

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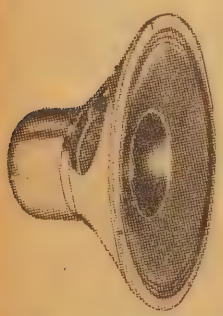

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INDUSTRIAL TIMING CIRCUITS

Readers who have been following the recent series on Industrial Electronic Equipment should also be interested in this additional paper by engineers of the Aerovox Corporation. It has to do particularly with the use of capacitors in control and timing circuits.

THE operation of fixed capacitors in industrial time-delay control circuits is based upon the time constants of resistance-capacitance and resistance-inductance combinations.

The phase-shifting property of R-C and L-C circuits is employed to obtain operation of an electrical device or circuit interruption at some instant subsequent to applying the operating voltage.

The simple resistance-capacitance circuit is the basis of a number of timing devices in present industrial use.

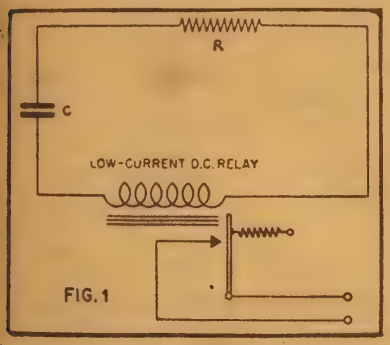

FIG. 1

The time constant of a resistance-capacitance circuit is the time required for a current in the circuit to fall to I/C or 0.37 of its initial value. Such is the case of capacitor discharge current flowing through fixed resistance, and is given as:

(1) $t = RC$ microseconds

R is expressed in ohms and C in microfarads

$\epsilon = 2.718$

The time constant of a resistance-inductance circuit is the time required for a current flowing in the circuit to change to a value of 0.63 (equal to 1-1/2.718) of its original or final value. This is the case of a current forced through a series inductor, and is given as:

(2) $$t = \frac{L}{R} \text{ microseconds}$$

R is expressed in ohms and L in microhenries

Equations (1) and (2) may be divided by one million to give the time constant in seconds.

Two rudimentary applications of the time constant of circuits to obtain time-delay operation in a simple manner are illustrated by Figures 1 and 2.

In Figure 1 it is assumed that the capacitor C has been fully charged from a direct-current source, that the charging potential has been removed from the circuit, and the arrangement shown in the schematic established.

The capacitor will then discharge through the circuit containing the resistor and any other series-connected electrical device (such as the relay coil shown) at a rate determined by the C and R values, assuming that the reactance and resistance of the relay coil are negligible.

The progress of current decay in similar circuits of low, medium, and high resistance is shown by the curves of Figure 1-A. It is seen from these curves that a high current may be maintained for a short time or a low current for a longer time, depending upon the circuit resistance. The curves are plotted for a given capacitance.

From such operation, it is easily understood that the relay contacts in the R-C circuit will be held closed by the capacitor discharge current until such instant as the latter falls below the minimum value

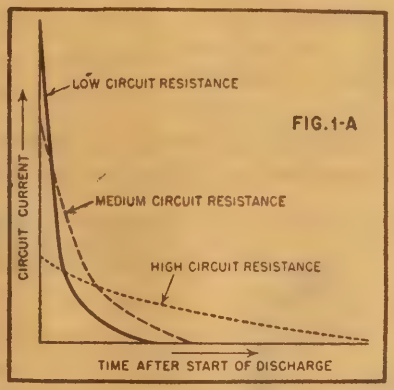

FIG. 1-A

necessary to maintain closure ampere-turns.

From Equation (1) and Figure 1-A, we observe that the interval of closure may be prolonged by increasing the value of C, R, or both.

The circuit of Figure 2 shows a rudimentary arrangement for obtaining a time-delay effect of the opposite kind. Here it is assumed again that the reactance and resistance of the relay coil are negligible and that the useful time lag is supplied by the series inductor L and series resistor R.

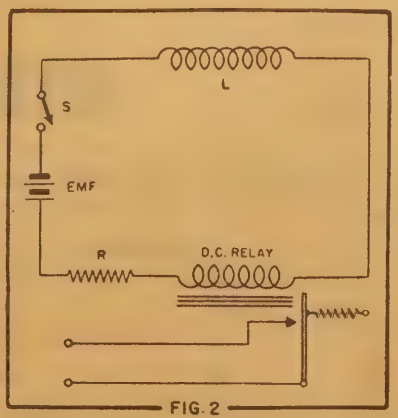

FIG. 2

When the main switch is closed, connecting the direct-voltage source to the circuit, a current builds up gradually to the level required to close the relay contacts at a rate determined by L/R.

Thus, we have in Figure 1 a relay which picks up immediately when the main switch is closed and continues to hold for a pre-determined time interval after the switch is later opened.

In Figure 2, on the other hand, we have a relay which picks up at some preset instant after the main switch is closed and drops out immediately upon opening the switch.

Figure 3 shows a simple capacitor circuit in which relay pickup occurs at the instant the main switch is closed and drops out at some later instant determined by the circuit time constant.

Operation is based upon charging current which diminishes to the drop-out value according to the RC rate. The charging current flowing through the circuit into the capacitor C is equal at any instant to:

(3) $$I = \frac{E}{R} \epsilon^{-\frac{t}{RC}}$$

I is the instantaneous charging current (amperes)

E is the charging potential (volts)

R is the circuit resistance (ohms)

t is the time interval measured from the instant of circuit closing (seconds)

$\epsilon = 2.718$

C is the capacitance of control capacitor (farads).

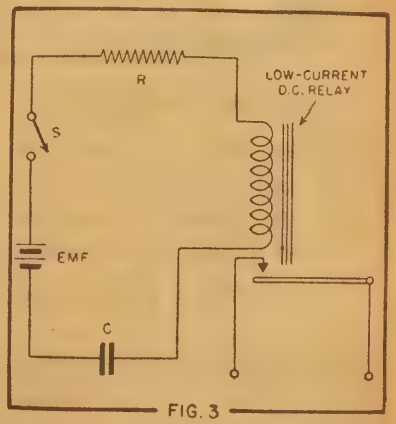

FIG. 3

The circuits of Figures 1 and 3 are useful for obtaining a delay in dropout, while those of the type illustrated in Figure 2 are employed for delayed pickup.

The relay contacts in the capacitive circuits are shown normally open, but reverse performance might be obtained by arranging the con-

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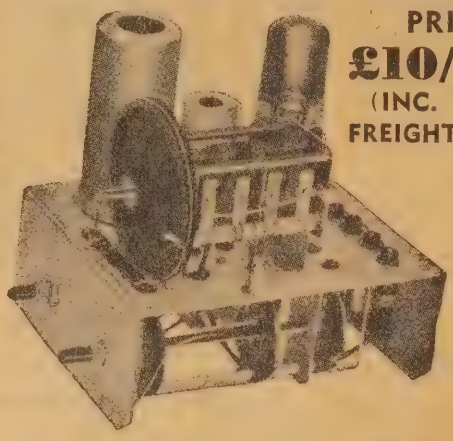

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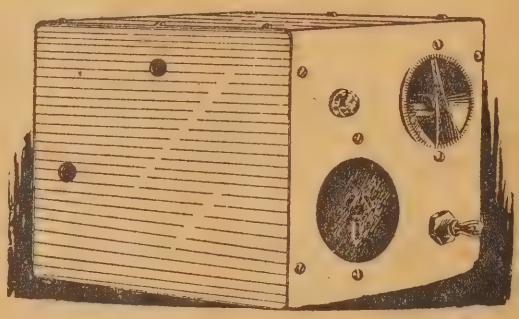

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tacts in the normally-closed condition.

In practical industrial timing circuits where a succession of operations are to be performed at various instants, special relay construction is employed in which several armatures are arranged on a single magnetic structure to be dropped out individually at preset instants.

In any of the simple circuits discussed thus far the size of the relay coil must be such that the required ampere-turns for efficient operation will be obtained with the current value available at the desired instant of operation.

Likewise, C in Figure 1 must be large enough to deliver the required

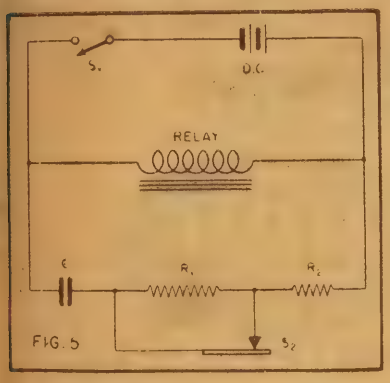


FIG. 5

discharge current over the selected interval of operation.

In practice, both the resistance and reactance of the relay coil must be taken into account in the design of the circuit. Simple circuits of the capacitive type, such as Figures 1 and 3, would demand low-current DC relays for direct application.

For most industrial timing-circuit applications, large capacitances will be required in order that the maximum amount of energy (expressed in watt-seconds for a given charging voltage) may be stored. The present availability of very high capacitance electrolytic units enables the design of capacitor-control circuits of high energy storage capability affording long time-delay intervals.

LEAKAGE IMPORTANT

The actual length of the delay interval may, of course, be governed by the control-circuit series resistance and does not depend largely upon the magnitude of charging voltage. The electrolytic capacitor is not applicable, however, to circuits in which zero current level must be reached, due to the normal leakage of these units. For these circuits, there are available oil capacitors of reasonably high capacitance.

One of the most important present uses of capacitor control is in the provision of successively-timed operations preceding or following interruption of the operating voltage. Motor acceleration is one such application.

In the capacitor-controlled motor-accelerator, successive values of starting resistance are cut out of the circuit automatically after the main power switch has been closed, this operation being performed entirely by capacitor-control circuits.

An interesting circuit for a motor controller of this type was in "Electrical Engineering" for February, 1940. Employed in this circuit are relays which pick up and drop out at preset times by means of capacitor control, and relays which drop various of their armatures at preset intervals.

The latter type relay is constructed by providing several separate armatures and sets of contacts for a single magnetic structure. The control mechanism (aside from the R-C control), which determines the instant at which these armatures are dropped out is the reluctance of the independent magnetic circuits—the dropping ampere-turns are adjusted by setting the magnetic gaps of the independent armatures when in the closed position.

This is a simple and effective means of adjustment, and its direct effect upon the time constant may be understood from examination of the equation:

$$(4) \qquad t = CR \log_{\epsilon} \frac{ni_0}{ni}$$

C is the capacitance of control capacitor (farads)
R is the control resistor value (ohms)
i_0 is the initial transient current (amperes)
i is the transient current (amperes)
t is the time constant (seconds)
n is the number of relay-coil turns.

The motor controller of Figure 4 is arranged to start up a motor automatically and bring it up to its various safe speeds either in the forward or reverse directions.

AUTOMATIC CONTROL

The arrangement is such that the starting resistors R1 and R2 are in series in the starting condition and are automatically cut out successively as the motor gains speed.

It would involve more space than is available here to detail the complete sequence of operations which follows operation of the main switch. The circuit will, however, indicate the degree of complexity, which can be involved by automatic starting circuits.

Figures 5, 6, and 7 show other capacitor-control circuits for various particular functions. In Figure 5, when the main switch S1 is closed, curent from the source DC picks up the relay. The auxiliary contacts S2 are closed at the same time by ganging with S1, short-circuiting the high resistance R1 to permit control capacitor C to charge rapidly through the low resistance R2. The latter has been inserted in the circuit specifically to limit the current through the S2 contacts to a safe value.

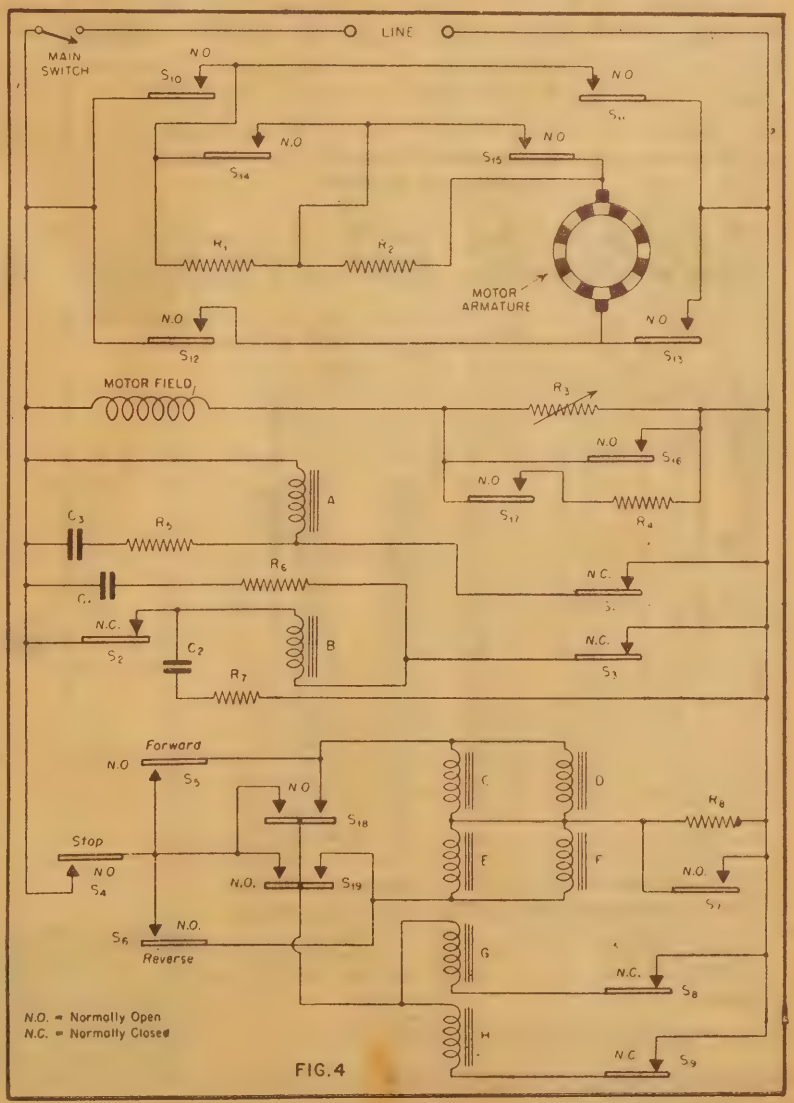
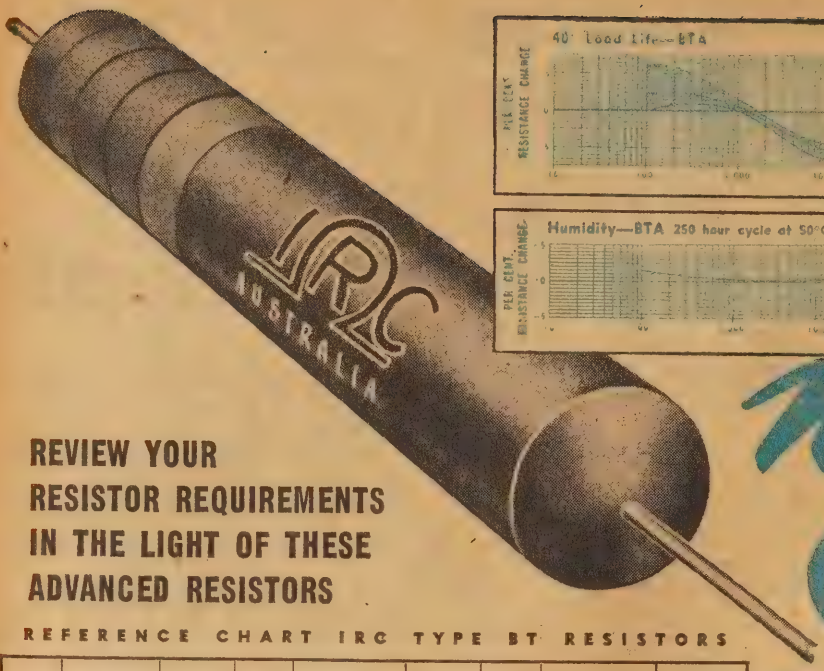
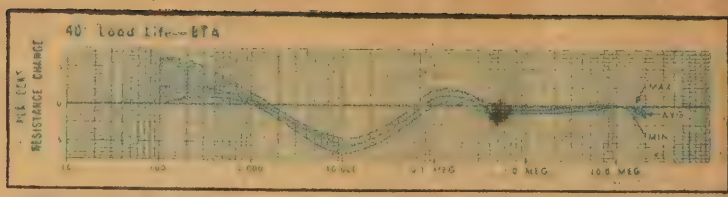
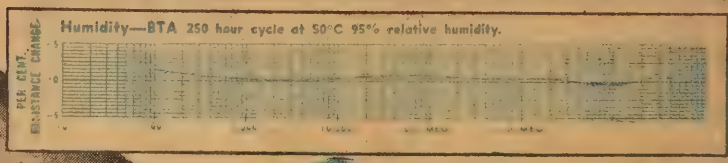


FIG. 4







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11†	*			—	110	1,100	11,000	0.11	1.1	11.0
12	*	*		—	120	1,200	12,000	0.12	1.2	12.0
13†	*			—	130	1,300	13,000	0.13	1.3	13.0
15	*	*	*	—	150	1,500	15,000	0.15	1.5	15.0
16†	*			—	160	1,600	16,000	0.16	1.6	16.0
18	*	*		—	180	1,800	18,000	0.18	1.8	18.0
20†	*			—	200	2,000	20,000	0.20	2.0	20.0
22	*	*	*	—	220	2,200	22,000	0.22	2.2	22.0
24†	*			—	240	2,400	24,000	0.24	2.4	—
27	*	*		—	270	2,700	27,000	0.27	2.7	—
30†	*			—	300	3,000	30,000	0.30	3.0	—
33	*	*	*	—	330	3,300	33,000	0.33	3.3	—
36†	*			—	360	3,600	36,000	0.36	3.6	—
39	*	*		—	390	3,900	39,000	0.39	3.9	—
43†	*			—	430	4,300	43,000	0.43	4.3	—
47	*	*	*	—	470	4,700	47,000	0.47	4.7	—
51†	*			—	510	5,100	51,000	0.51	5.1	—
56	*	*		—	560	5,600	56,000	0.56	5.6	—
62†	*			—	620	6,200	62,000	0.62	6.2	—
68	*	*	*	—	680	6,800	68,000	0.68	6.8	—
75†	*			—	750	7,500	75,000	0.75	7.5	—
82	*	*		82	820	8,200	82,000	0.82	8.2	—
91†	*			91	910	9,100	91,000	0.91	9.1	—

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When S1 and S2 are subsequently opened, the relay does not drop out immediately, but continues to hold through action of capacitor discharge current flowing through the two resistors in series. Dropout occurs at the instant that the discharge current falls below the minimum value required to maintain the holding ampere-turns.

This circuit is employed in cases where low pickup requirements permit a low value of relay ampere-turns. A high-resistance, high-turn coil may thus be used, and the capacitance of the control capacitor materially reduced.

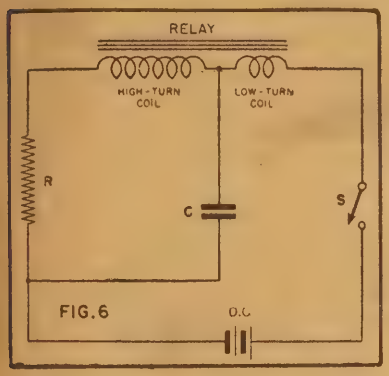

FIG.6

The relay shown in Figure 6 has two coils wound upon the same core. One has a large number of turns; the other a small number. The low-turn coil provides the high value of ampere-turns required for picking up the relay armature against strong spring bias or gravity pull.

When switch S is opened, the armature is held during the delay interval by discharge current from capacitor C flowing through the high-turn coil and control resistor R.

The circuit of Figure 7 has been designed for rapid pickup and rapid drop out. A special dual relay winding is provided consisting of a high resistance coil and a low-resistance coil,

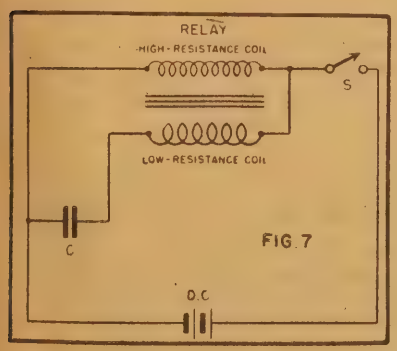

FIG.7

both containing the same number of turns wound upon a common core.

The low-resistance coil provides a high value of ampere-turns for quick pickup. When switch S is closed, current flows through the coil and into capacitor C, picking up the relay. This charging current is of short duration.

When the switch is later opened, capacitor discharge current flows through the two coils in opposite directions, giving rise to bucking fields, and the relay quickly drops out.

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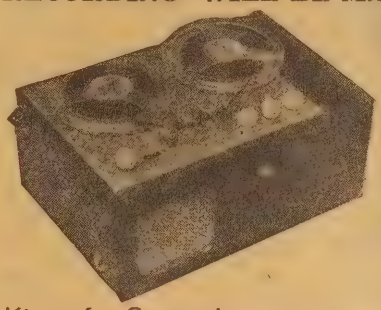

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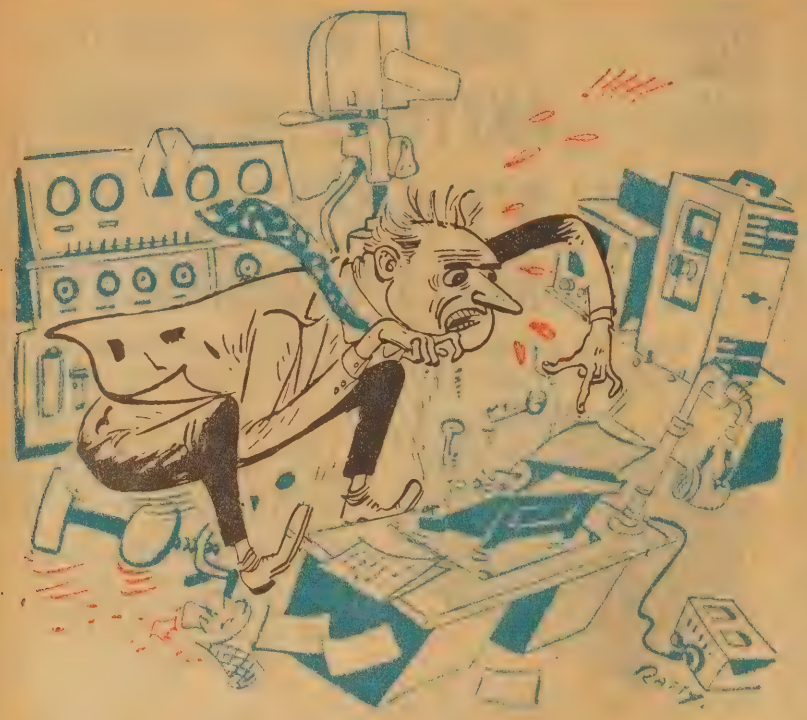


Let's Buy An Argument

Obviously puzzled, a reader has written in to ask why pick-up response curves, as published in Radio & Hobbies, differ so markedly from those published elsewhere. Are our instruments faulty, are we careless, is the manufacturer dishonest in his claims or is there some other not-so-obvious reason?

by Neville Williams

FAR from being new, the subject was thrashed out pretty thoroughly a couple of years ago, as some of you may remember. Others may not, however, and a brief repetition of the salient points may be permissible at this juncture.

Of the possible explanations suggested above, the last one is nearest to the truth, except that it should be written in the plural—there are several not-so-obvious reasons which could account for the discrepancies.

After one has surmounted the usual difficulties of fixing load conditions and allowing for (or ignoring) the test recording characteristics, the most important "not-so-obvious" variant appears to be the way the individual stylus fits the individual groove.

THINGS THAT MATTER

It involves the initial dimensions of both groove and stylus, the amount of subsequent wear each has suffered, and the degree to which the particular pickup relies on groove fit to damp its own resonances. Perhaps that last is a rather loose phrase, but we'll let it stand.

Stylus fit is not a minor, second-order effect. It can make decibels of difference to the curve, particularly in parts of the spectrum where the pickup tends to exhibit resonant effects. It can turn a peak into a trough and vice versa in an extreme case.

What brought the matter to our notice so forcibly, when we wrote earlier on the subject, were the conflicting results obtained during tests of the first lightweight pickups on 78 rpm.

With a number of different test records available and stylii ground to varying tip diameters, we were able to observe first-hand the importance of stylus fit throughout the whole upper register, both in terms of output and waveform.

We learned the fundamental lesson that individual response curves could not be treated as final and conclusive. That, at best, they could only indicate general trends.

Results vary inevitably with individual records, individual stylii, individual pickups, being influenced also in some cases by ambient temperature and humidity. The true value of a design can only be based safely on an observation of many such curves.

WITH ORDINARY RECORDS

The disturbing point is, of course, that the same variations must occur when the pickup is used to play standard pressings, with no way available to measure the end result. Nor am I convinced that groove and stylus tolerances will be held much closer for the ordinary run of microgroove equipment than for the 78's.

The way varying interests have already played fast and loose with compensation curves is certainly not reassuring.

The natural impulse of an engineer who sets out to make a test record would surely be to hand-pick his stylus and master, and to double-check the frequency response of his channels to a fraction of a decibel. There would be no arbitrary fiddling with equalisation.

Likewise, at the playback end, the testing engineer is not going to waste time with partly-worn stylii, or with pickups not in the very best condition.

If, after all that, notable variations in response can occur, with visible waveform distortion, what must be the variation in ordinary recordings pressed under a variety of conditions and played with pick-ups and stylii ranging from brand-new to worn-out?

ROOM FOR ARGUMENT

No wonder there are arguments about records being "clean" or "dirty" in the electrical sense. And how futile to read from a single curve any more than a pickup's general qualities!

By way of illustration, we had occasion to run some curves recently on a crystal pickup, at both 78 and 33 rpm. For good measure, we used three different frequency records for 78 and two for 33.

While the curves agree in general tendencies, the differences are quite obvious, as you can see.

What is really staggering is the difference in behavior at about 13 Kc on the 78 rpm curves. A peak of 9db with one record corresponds with a trough of at least 6db in the other!

Of course, there's something wrong, but how would you ever know it if multiple tests did not show up the contradiction?

Let's say that you, as a manufacturer, were faced with a situation like this. Would you publish the curve showing a peak or the one showing a trough? Or would you simply take the average or mean figure and show it as a rise of just over plus 2db?

And, if you did, what would be the thoughts of a test engineer who later "rediscovered" the peak or the trough, according to the record he used?

OVERALL AVERAGE?

Go one step further. Let's say you had taken, as you undoubtedly would, complete sets of curves on a dozen or so pickups, using the widest possible selection of so-called "standard" test recordings. Would you not think it fair practice to average out all the readings and publish a single curve?

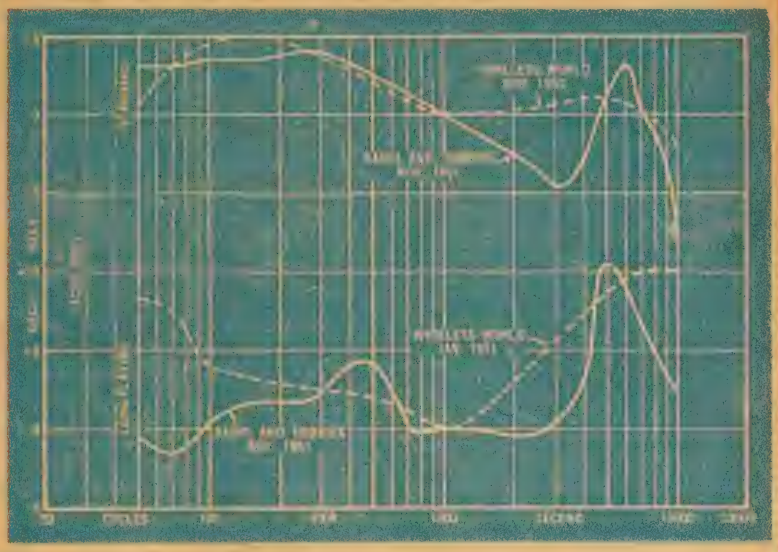
In so doing, the eccentricities of individual pickups, stylii and records would completely disappear, leaving you with an agreeably smooth-looking curve. But comforting and all that such a curve appears on the printed page, you can be quite certain that no one pickup you will buy would ever correspond with it.

Any single pickup will most certainly exhibit the usual eccentricities stemming from its own construction, its own stylus and from the record you happen to sit it on.

By way of good measure, you can add the possible effects of ageing, temperature, humidity and unrevealed production differences between one batch and another. We've come across all these.

Having taken the two sets of curves shown on these pages, we had a look at the manufacturer's

PICKUP CURVES—WHAT'S WRONG?



It seems to me that one of the easiest ways of "Buying an Argument" is to commit a pickup response curve to paper — for instance those for GP20 pickups that I have copied from Radio and Hobbies and from Wireless World.

First of all the two curves for the standard head version. Up to 1000 cycles they are in reasonable agreement, but above this there is no comparison. One curve shows a dip and a peak and the other a smooth response.

The two curves for the L.P. heads show an almost total disagreement. There appears to be no reason to doubt any of the figures quoted, so it is necessary to account for the discrepancies.

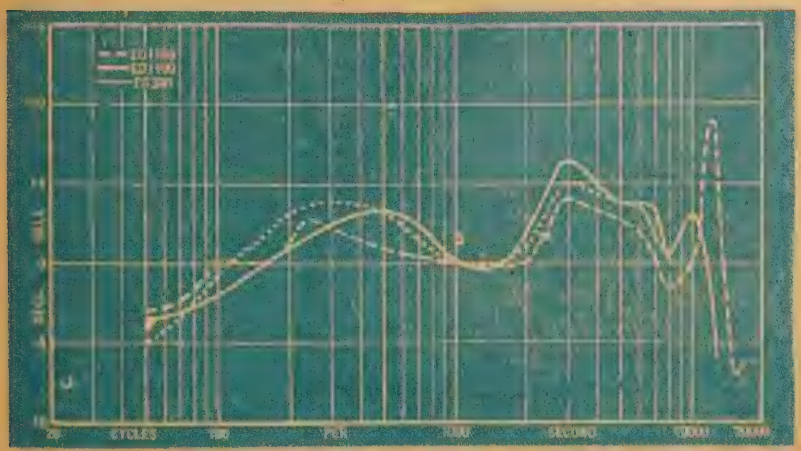
The test records used may have been different and in the case of the standard heads certainly were. The curve taken from Wireless World was done with Decca K1804 while the Radio and Hobbies curve was done with HMV ED1189. This should not of course make any difference but it does appear that the HMV record is more critical to use.

I do not know the source of the test records used for the L.P. tests but the Radio and Hobbies curve is again less regular than the other quoted. However, the difficulties that occur with standard test records should not occur with L.P. test records where the groove dimensions and the material are more standardised.

If one can place any reliance on test records we must assume that the performance of a GP20 pickup in Australia is different from its performance in England. Perhaps the high temperatures attained during shipment from England affect either the crystal or the plastic gel in which it is embedded.

I would be pleased if either you or your readers could throw some light on this mystery.

M. E. P. (Masterton, NZ).



Curves of a crystal pickup operating into a 0.5 meg. load and using three different 78 rpm. test records. The manufacturer's curve, which we have not reproduced, fails to show the rise around 4000 cps. Why?

published data on the same pickup, with the pickup operating into a 0.5 meg load.

While there was fairly close agreement up to 2000 cps and above 7000 cps, the manufacturer's curves completely ignored the obvious 4 to 5 db rise around 4000 cps. Why? Frankly I don't know. I can only surmise.

Lest you think that these effects are peculiar to crystal pickups, let me hasten to assure you that they're not. I was in the very act of checking proofs of this article when John Moyle walked in from the laboratory with a very puzzled frown on his brow: "My ——— pickup's got a real peak in it now", quoth he.

(The missing word is a brand name, not an expletive).

Some months ago he had checked this pickup — a magnetic type — and observed that its response was very good up to 13 or 14 Kc, with no more than a vague rise around the resonant frequency.

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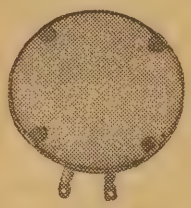

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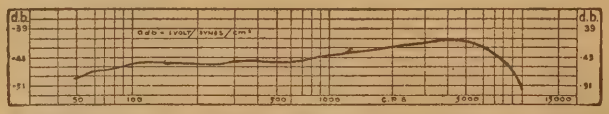

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The stylus had gradually worn, however, leading to slight distortion on the inner grooves and he had bought a new stylus.

When tested with the new stylus in place, the pickup showed a definite peak around 9Kc and evidence of groove skating. It could only be corrected by applying slight side pressure or weighting the head with ninepence (in silver).

The new stylus point may be slightly finer than optimum, it may wear into better shape, or there may have been a change in the pickup. The important thing was that something changed.

At this juncture I think I'd better stop; otherwise, far from explaining the variation in measured results, I'll have you believing that curves are completely useless.

Far from it. As I explained earlier, they show general trends more precisely than you can judge by ear, but more than that you can't expect. Except in the very specialised and expensive units, variations from the average are the rule, not the exception.

OTHER SUBJECTS

Passing reference to things great and small—space, time, electrons, &c—has prompted the usual amount of comment and argument, even in the precincts of our own office. They re ideal subjects for speculation, late at night, when the stars wink out and the mind turns easily to things distant and philosophical.

In such a mood and in such circumtances I might be willing to discuss things with J.G.K., whose letter appears elsewhere on the page. But I'm afraid that explanations of finite space and the expanding universe are a trifle outside the scope of these columns, not to mention yours truly.

On the other hand, if our friend thinks that his ideas warrant setting out in a letter, I'll be willing to withhold his name from the keepers of the said "giggle-house".

More down to earth is the letter from R.T., of Arncliffe.

By way of preamble, which we've omitted, he complains about Mr. Thomas' answer to his criticism of the tape deck design. He suggests that, when Mr. Thomas can't escape the truth of such criticism, he avoids the issue and "gets out from under" in a way that would make even a politician envious.

I'd rather stay on the sidelines and leave readers to be the judge in the matter. I hate blood at any time, particularly when it happens to be mine and all mixed up with printers' ink.

ROOM FOR ARGUMENT

Coming to the matter of valve types, it prompts me to observe that all design—whether of a radio set or anything else—is a matter of opinion and compromise. It is often very difficult to decide what, precisely, is "the best".

Ask half a dozen designers to produce a complete 4-valve mantel radio and I'll guarantee that they'll all come up with a different answer. They'll all have good reasons for their choice of size, shape and circuit and it's most unlikely that one set will be better than all the others in every respect.

It's no surprise, therefore, when a reader suggests that he would not have used the valve line-up that we specified for some particular design. There's a good chance that his preference was considered during the course of discussion and passed over for some perhaps quite minor reason. I can't remember a design yet where there hasn't been a good deal of discussion among the staff on the vital question of "what valves?"

The important thing is whether we had sufficient reason to use the valves we did, whether they will do the job, or whether our choice reflects a lack of care.

Why use the 5Y3-G rectifier when it is such a notably bad valve. But is it? There have been bad batches of 5Y3's to be sure, but we've also come across quite a few indirectly-heated rectifiers with shorts between heater and cathode.

Right now we have on a shelf a couple of 5V4's with half the filament open and a couple of odd 5R4's and 5U4's that seem to have lost their emission rather prematurely.

Despite these casualties, we're quite prepared to use any of these rectifiers where the circumstances might so dictate.

Of course, there have been valves which have proved unsatisfactory in one way or another from the word "go". Once their weakness becomes apparent, any designer will avoid them like a plague.

WILL USE IT

By and large, we're prepared to say that the history of the 5Y3-GT and its earlier prototypes is not such as to deter us from using it, if circumstances suggest that we should.

To consider one design from the January issue, the "Unit Playmaster" amplifier uses push-pull output valves and will draw 90-odd milli-

DOESN'T LIKE CHOICE OF VALVES

VALVE TYPES

Looking through the January issue of Radio and Hobbies, I notice that of four complete circuits contained therein, two of them use the type 5Y3GT rectifier valve. Besides the continual strain on the capacitors within the equipment, these valves are notorious for their unreliability. I have known of a number of cases where the valve has failed in a matter of weeks.

Considering these two factors, it surprises me that you continue to specify this valve type. The type 6V4 is cheaper and a far better choice, while for the case where more than 100 mA. or greater safety margin is required, the type 5V4-G is only a few shillings dearer and by all counts a very good valve.

The valve types used in all your circuits surprise me. The 6V6-GT is obsolete and has been replaced by two miniature types. Two further miniatures are again one step farther ahead in the matter of gain, always an important factor, except in a few cases.

Having used a large number of each type, I can say quite definitely that the EF86 is superior to the 6BR7, particularly when applied to tape amplifiers.

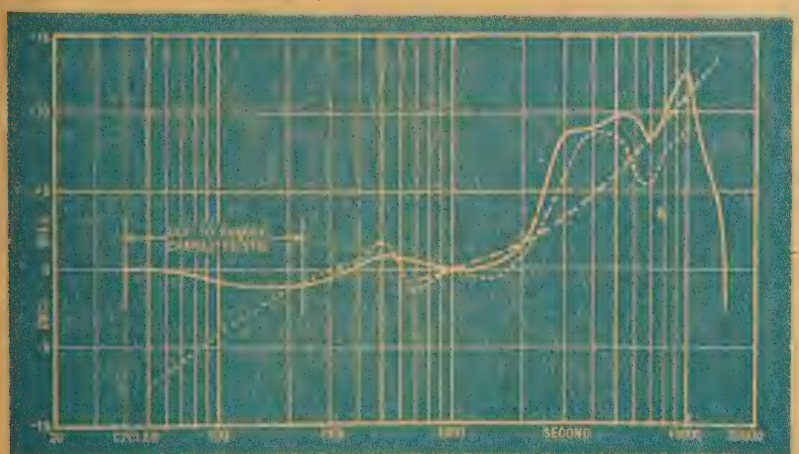
I notice that you have used a 12AT7 in the Playmaster No. 6 amplifier. Over the past two years I have built a number of amplifiers to this circuit, in each case using a 12AX7 valve. Since this latter is quite appreciably cheaper I do not see the reason for using the 12AT7.

R.T. (Arncliffe, NSW).

SPACE, GALAXIES, &c

By the way, has there been any satisfactory explanation of the following contradicting views? Prof. Einstein's theory of a finite space and the statements of the astronomers that there are galaxies travelling away from "us" and are in the act of disappearing. I've worked out a theory of my own but would probably be shoved in the "giggle house" if propounded.

J.G.K. (Neerim South, Vic.).



Curves for the same kind of pickup using two different microgroove test records. Treble response should be compared with pre-emphasis curve shown dashed, which is approximately correct for both discs.

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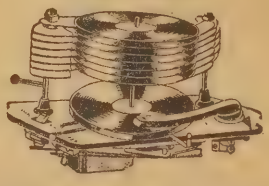

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amps, not including the possible tuner. Straight away this puts it beyond the capacity of the 6X4 or 6V4, and leaves only the 5V4 or 5U4 as alternatives to the 5Y3.

Both are dearer than the 5Y3 and both would give more output voltage than we need, which is a nuisance.

The other set using a 5Y3 is the "Fireside Five" and here I agree that either of the miniature rectifiers could have been used, provided there was enough filament power for the five valves plus dial lamp.

Most 60-milliamp transformers available only have a single 2.0 amp winding at 6.3 volts and the total drain would add up to slightly more than this. However, in practice, it's a rather trivial point and, as I said before, either of the miniature types could be used equally well.

I don't think the point about peak voltages is very important at the moment, because the standard mica and tubular condensers likely to be used in the high tension circuits will stand the peak of 225 to 285 volts. So also will the electrolytics.

It was different in the days when nearly every transformer had a 385-volt secondary. Peak voltages were really a problem.

FILAMENT CURRENT

But don't forget that point about filament current. There have been occasions when we've found ourselves with a standard transformer and not enough filament watts to go around.

Our use of the EF86 in the "Unit Playmaster" amplifier is witness to the fact that we were aware of its merits at the time. The "Tape Recorder No. 2" circuit, using the 6BV7 is an older design, reprinted in the issue for purposes of illustration.

At that time, we were very pleased to specify the 6BV7 and we still think it's a good tube.

Our correspondent's reference to the 6V6-GT is a little puzzling because we normally don't use the valve now in new designs. The trend is to use miniatures wherever convenient.

But remember that the 6V6 has higher ratings than the 6AQ5, the 6BV7 and the 6M5. That is why, in some cases, we have deliberately used the 6BW6, which carries the same ratings as the 6V6.

To be sure, the 6M5 and the 6BV7 are capable of higher gain and this is important on occasions. If the difference in size doesn't matter, we're as like as not to specify them in turns, to avoid the implication of being "married" to one brand of valve or the other.

NOT ALWAYS NEEDED

But high gain is sometimes a nuisance in the output stage, only increasing the chance of instability. If we're worried on this score, and not concerned about rating limits, a 6AQ5 is just as likely to find itself included in the parts list.

As for the twin triodes, the early history of availability was a very chequered one. First you see me, now you don't.

The 12AT7 was generally favored because it was more readily available than the others. It had the stage gain we needed and its low plate resistance suited better our ideas on tone control systems.

Since then it may have slipped into the "habit" class and we'll have another look at the situation next time a design calls for a miniature twin triode.

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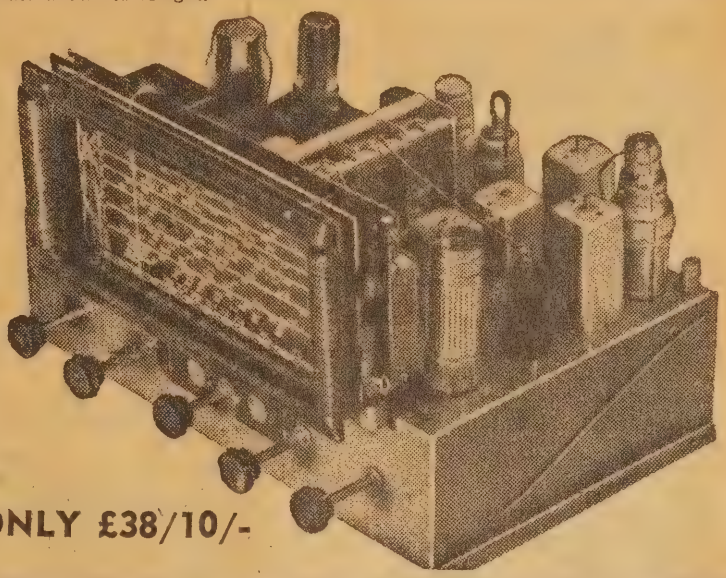

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FROM THE SERVICEMAN WHO TELLS

This month I intend to take things a little easier by relating only one original incident. The rest of the article is devoted to a discussion of cases and problems submitted by readers. The subject matter ranges from a faulty coil and IF transformer to an apparent but mysterious grid current effect.

ACTUALLY the case I have in mind bore a remarkable resemblance to one I had to deal with a few weeks ago and this, as much as anything, impressed it on my mind.

Answering a routine call, I was told that the set was very weak and had to be turned up a long way to hear anything at all. "Even then, it's not very clear."

I could only hope that it wasn't going to be too difficult, because the home was well off the beaten track (mine, anyhow) and I didn't want to burn up unnecessary petrol taking it back to the shop—the set, I mean!

VERY POOR

For a few moments after switching on it didn't sound too bad but the volume and quality deteriorated rapidly thereafter, turning the news service into an excellent demonstration of mumbling jargon.

Peeping into the back of the cabinet, the cause of the trouble was immediately evident—a blue glow surrounding the plates of the 80 rectifier. Obviously the electrons were having to pick their way from filament to plate through a rather dense cloud of gas.

For them, Royal visit crowds wouldn't be in it!

Happily enough, I had a new 80 with me and plugging it in, restored the volume and tone to normal.

On checking around the dial, however, the performance in other directions seemed very poor indeed. It was an old set, admittedly, but boasted an RF stage and, probably, a 175 Kc IF channel. Sets like that are usually outstanding in their ability to log stations. This one was hard put to it to get the locals properly.

Deciding to check further, I pulled the set away from the wall and inspected the aerial connection. The aerial was only the usual "bit of wire" hanging to the terminal but it became apparent immediately that connection or disconnection of the aerial made no difference whatever to the strength of the signals.

NO RF

Neither did my moistened finger, which is usually quite efficient as a picker-up of signals!

It must be a dud RF valve, I thought. Not having any 58's with me, I merely interchanged the RF and IF valves, knowing that the latter one at least was working in the set. But no, the changeover made not the slightest difference.

Ah, me, the chassis obviously had to come out of the cabinet.

There followed the usual wrestlings with old and recalcitrant knobs and ashamed remarks from the lady of the house about the amount of dust inside the set.

"I don't like touching the back of it . . . &c."

A few jabs with the meter established that the screen voltage was present, the cathode potential went up and down normally with the volume control setting—it was tied to the IF valve cathode—but the plate? Ah, yes, the plate! Not a mite of voltage on it.

Very obviously, beneath that dusty but dignified row of cans lay a primary winding that was no longer continuous. Wearily I gathered it up in my arms and marched off to the front gate. It was a job for the workbench, not the dining-room carpet.

In a case like this, one has the option of repairing the original coil and preserving the appearance of the set (if that matters) or fitting in a modern iron-cored coil, making the necessary adaptor plate and hoping that the set doesn't oscillate with the new coil installed.

After looking things over in this case, I removed the original coil and decided to repair it.

The primary was sadly corroded and called for sterner treatment than the mending of a single break. Accordingly, I stripped it right off and prepared to wind a new one. This involved putting a can of wax on the gas ring as the first action, then searching for a strip of empire cloth and some fine wire. I reckoned that, to see the set through its remaining few years, we needn't worry too much about exact specifications. After all, any primary is better than none at all.

After such thoughts, I proceeded to wind a layer of empire cloth around the "earthy" end of the coil, then over it to lay about 35 turns of fine wire, close wound. The grid end of this was connected to the "plate" lug on the old tripod former, the other end to the "B-plus" lug.

A bath in the hot wax followed, leaving the coil just as shiny and new looking as the day it was made.

The coil was duly wired back, peaked up and the set returned to its owner. This time it played all the local stations with the greatest of ease.

A week later I happened to meet the owner in the street and, with a grateful smile, she hastened to tell me that the set was "just wonderful" . . . "Better than it's ever been."

Strange how people forget how good their set really was when they first bought it!

But why should I care? I got my fee, didn't I?

And now for some of my readers' comments. First contribution comes from Mr. W.R.F. and I quote the essential part of his letter below:

OSCILLATION TROUBLES

The set in question was a 5-valve dual-wave table model and had come in for resetting of the dial calibrations, which were all approximately ½in out. Well, that was an easy one and the correction having been made by resetting the drum on the gang spindle, the chassis was refitted to the cabinet and turned on for a final check.

Then the fun started. 2FC played OK and calibration was OK, but on going down the band from 2BL to 2KY, a really fierce oscillation took over, but below this things were normal again, the calibration being OK.

Well, the chassis came out and the bypasses were checked, &c., but without result. The Sig. Generator was hooked up and the gain checked. This proved to be down in the IF channel and the primary of the first IF would not peak, the core wanting to go right in. A 100mmf. was placed across the primary externally and the core adjusted. Lo and behold, the gain was back to normal and the oscillation had disappeared.

Well, the IF was removed and a new shunt condenser fitted, the original having gone O/C. It was replaced and relined and things were back to normal.

On thinking over the cause of the oscillation, apparently the inductance of the coil together with the stray capacity of the circuit was tuning somewhere near the centre of the B/C band (by the way, apart from

☆

This diagram shows the electron path caused by grid emission. The grid may be likened to a second cathode and it becomes positive by virtue of the grid resistor. Increased heat which it causes creates a snowballing effect.

☆

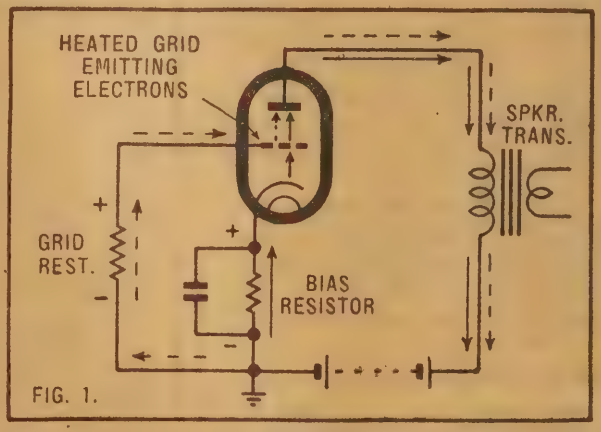

FIG. 1.

lack of gain, S/W range was OK) and together with the B/C aerial coil was forming a TPTG oscillator and it was REALLY oscillating, you could get quite a decent spark (RF) off the converter plate when touched with the meter test prod.

It is the first time I have struck this fault and although it sounds rather tame when you know the cause and the answer, it was a teaser while it lasted.

SIMILAR TROUBLES

Yes, things like this can be a teaser and the fact that most modern sets have more gain than necessary for local operation tends to cloud the issue. It is often difficult to detect even a large falling off insensitivity until the generator is brought into play. I know that the facetious ones will say, What does it matter if you can't hear the difference?, but the point is that the drop in gain usually provides the vital clue to the trouble. such was the case in the set mentioned above.

Even worse than the O/C condenser which our friend mentions is the one which drops its Q. I may have mentioned before that this did happen a few years ago, and not merely to one set, but to a whole batch from a well-known maker.

They used imported condensers from Europe, if I remember correctly, which initially tested 100 pc. They were also supposed to have excellent stability characteristics, but this was where they fell down badly and, a few months after going into service, they commenced to deteriorate.

The result was a flock of sets from the country areas (where sensitivity really does count) which could only be described as "completely gutless". Furthermore, they had completely baffled the local servicemen, who could only confirm that the IF channel was very weak. This was not surprising, because it took a well-equipped laboratory to track down the trouble.

When this was done there came the task of recalling as many as possible of the sets and fitting them with locally-made condensers, which proved perfectly satisfactory.

ANOTHER READER

Another letter comes from Mr. R.L.T. and is somewhat different in that it is not a service case in the normal sense but a problem which the writer encountered and which, although he cured it, continues to puzzle him as to the actual cause. However, here is his own story:

While building some prototype equipment which contained a 6M5 output valve as a normal output stage to speaker in part of the equipment, I wired it up in the normal manner with the customary grid and cathode resistors on the 6M5.

However, shortly after turning the equipment on for the first time I noticed the 6M5 plate was glowing red. After hurriedly turning it off, I hooked the VTVM on to the grid to see what happened there.

After warming up a very small positive potential appeared on the grid, .1 to .2 V only. However, within a few minutes the potential began to rise steadily. I followed it up to 100 V positive, more than the previous valve plate voltage, and then turned the equipment off. I noticed that the cathode potential was at all times a couple of volts higher. It looked very like a leak between cathode and grid somewhere.

To cut a long story short, I changed everything, valves, valve types, sockets, coupling capacitors, grid leaks, earth points, parasitic suppressors, cathode resistor, the whole works except the output transformers all to no avail.

Some valves, notably some 6L6-G's did not give the effect, all others, 6V6, 6BW6, 6Y6, &c., did. I did not wish to change the OPT, so must assume that the trouble was in some vague way connected with that item.

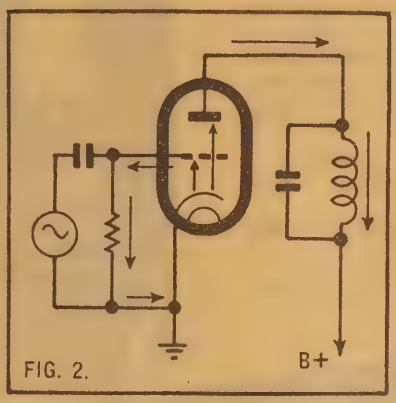

FIG. 2.

Showing the electron path which occurs when the grid is deliberately driven positive in an oscillator circuit. It is the exact opposite of the previous case and produces negative grid bias.

The final cure was the obvious one and the one which on principle I did not want to use. That consisted of lowering the grid leak from .5 to .15 meg. and slightly overbiasing the valves.

I might add that there were no parasitic oscillations unless they were around 10 Mc. since neither my CRO nor my VTVM could detect any. Since the grid and screen stoppers were correctly fitted I see no possibility of this.

I should be very glad to hear of any case similar to this that I struck.

GRID CURRENT

It seems almost certain that this trouble was due to grid current and that this was due, in turn, to grid emission. Similar effects can be caused by gassy valves, but it would be unlikely that all the valves which exhibited this effect would be faulty.

The story of grid emission is a very interesting one and worth considering in some detail.

Let us assume that we have a typical power output stage as shown in figure 1. Commencing at the negative terminal of the power supply electrons will flow through the cathode bias resistor to the cathode of the valve. At this point electrons are emitted by the cathode and move across the intervening space to the plate. From here they flow through the speaker transformer to the positive terminal of the HT supply. This path is shown in solid arrows.

The flow of electrons—or current—through the bias resistor develops a voltage dependent on the value of resistor and the rate of flow, this bias being effective at the grid because of the grid resistor. So far, i good, and I imagine that everyo is still with me, but perhaps tempt to ask, "Well, so what? We kn all that."

Now enters the villain of the pie —grid emission. It is probably s to say that every grid that ever w has emitted some electrons unc normal conditions but that this eff is never noticed provided the val is operated within normal ratings.

HEAT FROM CATHODE

The main cause of such emissi is simply that the grid is locat close enough to the cathode to acqui considerable heat from it as w as a sprinkling of cathode coati Obviously it will liberate electrons, the heat is sufficient and the adjace electrostatic field strong enough.

Now let us consider what happe when things don't go quite accordi to plan.

The grid, in emitting electron loses some of its negative char (electrons being negative) and becomes positive, in this case wi respect to chassis to which is co nects via the grid resistor.

The emitted electrons are attract to the plate and the complete pa of this new current is from the neg tive terminal of the power supp through the grid resistor to the gri then to the plate and back to t positive side of the power supply v the speaker transformer. This pa is shown in dotted arrows.

For a given number of electro emitted (that is, a given grid cu rent) the resultant positive char will vary directly as the value of t grid resistor, the higher the grid r sistor the greater the positive charg This is merely a practical expressio of ohms law, but it is a most impor ant point.

The effect of the positive char on the grid is to reduce the tot effective negative bias. As a resu the plate current rises, increasi the temperature of the valve, furt er aggravating the grid emissio again reducing the bias, increasi the plate current, raising the ten perature . . . and so on!

And so the process goes on, snow balling to the point where the equi ment is either turned off because is not performing properly or t valve concerned wrecks itself.

WHAT CAUSES IT?

Now the all-important question Why does this effect show up in o particular valve or piece of equi ment and not in others, particular as I remarked earlier that it is like that all grids emit to some exten

The main reason why this do not occur in the average receiv is because the circuit is deliberate designed to prevent it. The val manufacturers specify a maximu value of grid resistance for any pa ticular valve type and operating co ditions and they will not guarant satisfactory performance if this exceeded.

This value is so chosen that, wit the normal grid emission for th valve type, it would only permit very small voltage to be develope across it. As a result its effect o operating conditions will be negl gible.

Further protection is provided b the self biasing arrangement normall used since any increase in plate cur

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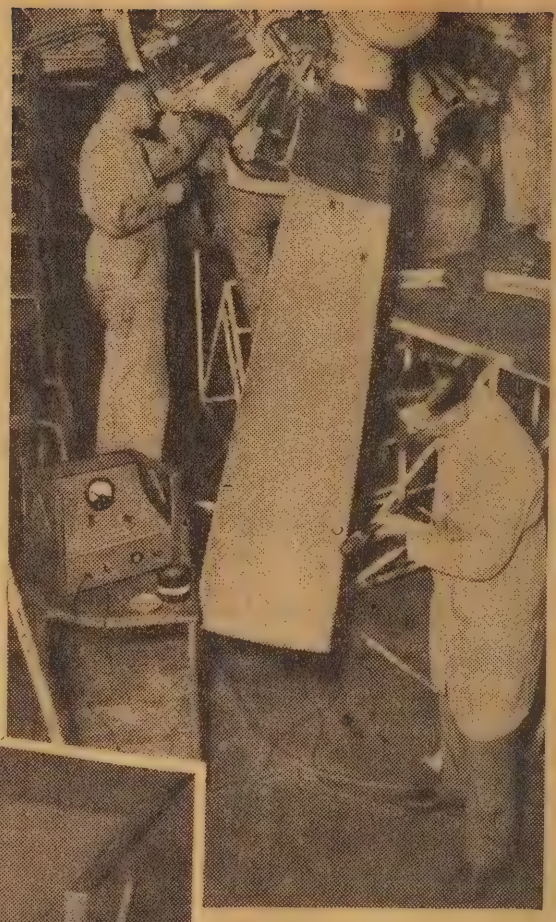

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rent due to grid emission will increase the bias, thus tending to offset the tendency of the valve to "run wild". There is, of course, a limit to the amount of protection which this circuit can afford, but it is the reason why valve manufacturers specify a much lower value of maximum grid resistance when the valve is operated with fixed bias rather than self bias.

The reason why an occasional set-up, such as that described in the letter above, should run amok is not quite so easy to explain, since everything appears to be according to accepted practice. It is difficult to diagnose faults by letter (I have already expressed my sympathy to the Radio and Hobbies staff in a previous article) but there appear to be two factors which, singly or together, might have contributed to this spot of bother.

RUNS TOO HOT

One is the possibility that the power valve is poorly ventilated and thus prone to run at higher than normal operating temperature. If so, it would be easy for the grid emission to be excessive and to set in train the sequence of events just detailed.

While on the subject of operating temperature it is significant to note that power valves, which dissipate more heat than other types, have the lowest grid resistor ratings. As far as I know this figure has never been higher than .5 meg. for any AC operated power valve, and this is assuming the protection of self bias. Where fixed bias is used it may be as low as 50,000 ohms.

RF valves, having less heater dissipation, are normally rated at between two and three megohms and, if you are wondering how such values would normally occur in an RF stage, remember that the grid return circuit of such stages is usually through the AVC network.

Coming still further down the scale we have the resistance coupled stage. Valves used in these applications have a similar cathode to those used in RF stages but operate with very much lower plate and screen currents. (Normally only a fraction of a milliamp.) Provided certain precautions are observed, such as the value of the plate load resistor, it is permissible to use up to 10 megohms in such grid circuits.

UPSETS READINGS

In some special circuits, such as vacuum tube volt meters, it is very important to use high values of grid resistance which would normally lead to trouble in the form of grid current and "creeping" of the meter's characteristics.

Once again the problem can only be solved by reducing the heat, this time by operating the heater at reduced voltage, usually about 4.5. Naturally this reduces the efficiency of the valve to some extent, but this is often of less importance than the high grid resistance requirement.

The other possible cause of my correspondent's trouble is that the valve is being slightly over-run, and if this condition was combined with poor ventilation it would almost certainly lead to trouble. Weight is lent to this theory by the fact that the 6L6, which has higher plate and screen dissipation ratings than the other types, did not appear to suffer from the trouble to nearly the same extent.

I would suggest that the correspondent make sure that his meter is okay, then check the applied plate and screen voltages and—most important — check the heater voltage. Another volt would make a lot of difference.

The valve manufacturers point out that it is possible to increase grid resistance above that specified, provided the dissipation of the valve is reduced accordingly. Which is only another way of saying that if the valve does not get as hot as normally the grid emission will be less and more resistance can be tolerated.

Just to round things off, we might consider another case where a grid runs positive though, paradoxically, this is arranged deliberately and is used to generate negative grid bias. As you may have guessed, I am referring to the generation of grid bias in an oscillator circuit, a phenomenon which most of us are inclined to accept without too much thought as to the whys or the wherefores.

DEVELOPS BIAS

A typical circuit is shown in figure 2 and the operation may be described as follows: The grid, initially, is at the same potential as the cathode, being connected to it through the grid resistor. When the circuit commences to oscillate the grid is driven alternately positive and negative and it is during the positive cycles (or part of them only in many cases) that bias is generated.

The conditions differ from those of grid emission in that the grid of a power valve is normally held at several volts negative to control the plate current and allow the valve to operate correctly. The effect of grid emission is to reduce this bias, but it is only in extreme cases that the grid actually becomes positive with respect to the cathode, since the grid emission has to overcome the grid bias first.

As a result the grid will never attract any electrons to itself to replace those lost by emission. As far as the cathode is concerned the grid is still negative and not eligible for any electrons.

On the other hand the oscillator circuit, having commenced with a grid at cathode potential ,is able to drive the grid really positive to the point where it will collect a fair proportion of the electrons emitted from the cathode. The result, as shown in the diagram, is quite different. E now flow from the cathode grid, through the grid resis back to the cathode. The dire flow through the grid resisto the opposite of that which occ to grid emission.

Because the flow is in the direction the polarity caused also opposite, with the result grid end of the resistor is mac tive and the cathode end Normally this would not be much use because the required tial would disappear as soo applied voltage dropped to became negative.

STORES CHARGE

This is prevented by the c capacitor, which stores the n charge generated by the grid large enough to maintain th negative until the next positiv In the case of a class C stage t will normally be held negat something like twice the plate cut-off value and plate curre grid current—will flow only the peaks of the positive cycle.

Which, I think, just about s the story about positive grid current, and the like. At first it reads more like a "Radio Ir Easy Lessons" script than the ences of a serviceman but it r not as far away from everyda lems as one might imagine. I ways a help to be conversant w nature of such problems. Aft my correspondent could just as dump his problem on your c and say "Fix the thing."

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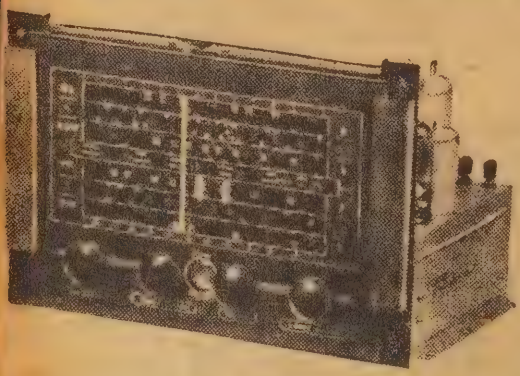

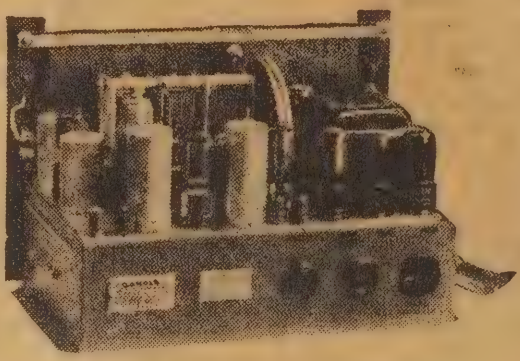

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Here's your answer, Tom!

A couple of Tom's questions are longer than usual this month which means that there is only room for answers to four of them. Some readers who have sent in questions recently may have to wait until next issue but we are sure that they will find the following questions and answers interesting in the meantime

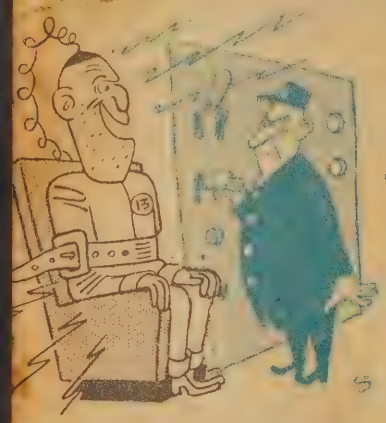
ere they are—

What is the lowest voltage that ill give you an electric shock?

Vell, Tom, that isn't a question to ch you can give an answer in ns of so many points so many s.

or a complete answer you would d to consult a psychologist as well an electrical man because it de- ds as much on the "you" and the t of the "you" as it does on the tage. We will do our best to fill h roles.

irst of all, it is necessary to de- what is meant by an electric ck. An electric sensation in its lest form could hardly be de- bed as a shock. There is a ting- sensation similar to that when blood circulation returns to a b after it has "gone to sleep".



Enough resistance . . .

h its more severe form, an electric sation can become quite unpleas- Taken even further it can cause onsciousness, failure of respiration in the extreme, death. Fortun- y, we haven't as yet had any ex- ience which could be classified in last bracket, and, as far as we w, the only practical use of the l effect of an electric current is in cuting criminals.

t appears that the effect of elec- ity on the body is dependant on density of the current through tissue. Therefore, the problem omes one involving ohm's law. If resistance of the body is low, a current will flow for a given tage, and so the sensation will be at.

We have yet to meet the criminal o can work up enough resistance withstand the voltage available at ell-known prison across the other of the world.

However, for most cases in which you will be interested, the resistance through the body can be considered as relatively high. A fairly high voltage is required to be noticed.

If your hands are dry, you will measure a resistance of the order of 50,000 ohms between them. On the other hand, if they are damp with perspiration and the area of contact is great the resistance may be much lower than this.

In the first case, you may be able to put one hand on each of two terminals separated by a potential difference of 100 volts without even being conscious that the terminals are alive. On the other hand, while working on your car with perspiring hands, you may get quite a noticeable sensation from a 12-volt car battery.

If the terminals of a 1.5-volt battery are placed across the tongue you will feel a noticeable tingle. The saliva apparently increases the conductivity to a marked extent.

LOWER VOLTAGE

In some factories, numbers of unskilled persons are required to operate soldering irons and other electrical devices where there is a possibility of faults occurring. In such cases it is usual to standardise on a voltage of the order of 32. Even if it is possible to "feel" the current there is little likelihood of an unpleasant shock, even in the case of particularly sensitive persons.

I have built the AC-DC multimeter described in the May, 1952, issue of Radio and Hobbies with great success, except that I cannot read AC milliamps. I am very puzzled because I have checked the circuit and I am sure that it is correct. A friend tells me that the resistance of the rectifier is too high for such small currents, but I cannot see this. If it affects the milliamps scale in such a great proportion, why not the voltage scale?

Let's take a deep breath while we work that one out. It requires quite a long answer, but a number of other readers seem to have similar troubles, so that it would be a good idea if we try to give you the full story.

Your friend's comment on the rectifier contains a good deal of truth. Its internal resistance is comparatively high and furthermore it varies as the current through the rectifier varies.

Don't be discouraged if you find this idea hard to grasp at first meeting. An example will help to clear the matter up. One of the most common non-linear resistances is an ordinary electric lamp. With no curre flowing, the filament is cold and t resistance of the lamp is low. Th means that a high current flo when the lamp is first switched o However, as soon as the curre starts to flow the filament temper ture increases, together with its r sistance.

If the voltage of the supply r mains constant, therefore, the curre decreases until it reaches a state equilibrium when a steady curre flows.

NON-LINEAR SCALE

The difficulty when a non-line device is used in a meter circuit that the scale will also be non-linea

Consider for a moment what ha pens when a meter is connected one of the usual bridge rectifie From your multimeter circuit, y will remember that the DC term nals go to the meter movement ar the AC terminals are brought out that the meter plus rectifier can l considered as a two-terminal devic

This device will behave as an A milliammeter and with certain restri tions which we are about to me tion, and can be connected into ci

A white elephant . . .

cuit in the same way as an ordina DC milliammeter.

There is a slight change in the se sitivity. A typical DC milliammet will have a resistance of 100 ohn and require a current of 1 mA f full scale deflection. With the rect fier connected, 1.1 mA RMS AC w be required. For convenience sc manufacturers start with a me having a sensitivity of about 0.9 m so that the sensitivity with the re tifier connected is 1 mA.

So far so good. However, the

ance of the arrangement is no
ger effectively 100 ohms. In a
ical case, with 1 mA flowing, it
uld be about 700 ohms. The snag
hat with 0.5 mA flowing it will be
the order of 1000 ohms, and may-
2000 ohms with 0.1 mA flowing,
to the non-linear character of the
tifier.
f you consider only the 1 mA AC
le, this will mean only that the
tage drop across the instrument
l not be proportional to the cur-
t flowing, even though the deflec-
of the meter will be.
he power taken by the instru-
nt will be much greater than that
en by the equivalent DC instru-
nt, but still not excessive for many
plications.

RIES RESISTORS

Multimeters, which include AC
tage scales, simply take this basic
mA AC movement and place re-
ors in series with it.
For example, in the case of the 10
scale, the series resistor would be
000 ohms, less the resistance of the
ter circuit. In this case, say, 9300
ns. Because the resistance of the
ter increases as the current de-
ases, the scale will not be linear.
r this reason, most commercial
ltimeters include a special scale
the low range.
For the 50 V and higher ranges,
change in the resistance of the
ter is very small in comparison
th the total resistance of the cir-
t and is usually neglected.
The position is not so simple when
comes to extending the current
les. While it is possible to extend
scales simply by wiring a resis-
in parallel with the terminals
the basic 0-1 mA AC meter, there
good reasons for not doing so.
For full-scale deflection it is neces-
y to develop about 800 millivolts
oss the shunt and the amount of
wer going to waste becomes ex-
ssive. Even more serious than this
the fact that resistance of the rec-
er is affected by the surrounding
nperature. The change may be as
eat as 1 pc per degree centigrade.
is means that an AC ammeter,
ploying a simple shunt circuit
uld vary greatly in its readings,
pending on the temperature.

OT VERY SERIOUS

In the case of a voltmeter this
ange is usually not serious because
the very much greater resistance
the external circuit.
In practice, the problem is over-
me by employing a transformer
ich is usually referred to as a
rrent transformer". The basic
mA AC meter circuit is connected
the secondary of the transformer
d the current to be measured is
ssed through the primary.
The combined resistance of the
ter plus rectifier is reflected to
primary of the transformer in
ordance with the turns ratio. If
ere are few turns on the primary
igh current will be needed to de-
op the required current in the
ondary and hence the meter cir-
it.
The resistance of the meter varies
different currents and therefore
e resistance reflected by the trans-
mer windings will vary.
here are few applications where
will be of any importance. The
voltage developed across the transformer primary becomes smaller for the higher current ranges so that the total amount of power drawn from the circuit is small. Finally the scale is linear because the deflection of the meter is proportional to the current.

MATTER OF COST

The reason why current transformers are not included in ordinary multimeters?

As for most things, Tom, it boils down to a simple matter of £sd. It adds about £10 to the price of a multimeter to add a current transformer because the transformer has to be of very good quality in order to work properly.

We admit that the engraved scale of the multimeter would lead you to believe that it would be possible to read AC on the current scales, but most people using multimeters are familiar with their limitations, and therefore we do not bother to make a note of the fact that the ranges are not available.

For most radio work, it is not essential to have a multimeter able to read AC current. Either it is not necessary to know the exact current flowing, or the information can be obtained indirectly using the resistance and AC voltage scales. In m
service workshops a multimeter w
AC current scales is something
an expensive white elephant and w
wants a white elephant in the wo
shop?

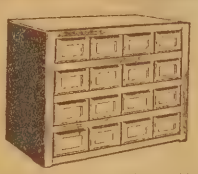
**I have noticed that Radio
Hobbies has used some capacit
marked pf. Could you please
plain this and tell me where I m
obtain this type of capacitor? I
pf anything to do with mfd?**

It's really quite simple, Tom. T
farad is the unit which is used
measure capacitance. You are
miliar with units to measure leng
For example a piece of string
feet long is twice as long as
piece of string one foot long. Si
larly, a 2 farad capacitor is tw
as large as a 1 farad capacitor.

The size of the farad was fix
by some fundamental electrical
lationships and in practice it pro
far too big. However, 1-millio
part of a farad or a microfa
proved to be a workable unit
many applications.

Some very small capacitors
used in radio equipment working
high frequencies, and even the
crofarad is somewhat large.

(Continued on Page 79)



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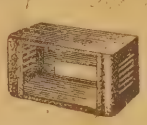

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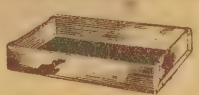

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17 x 10 x 3	.. .. ..	19/11

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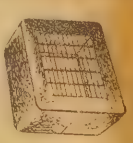

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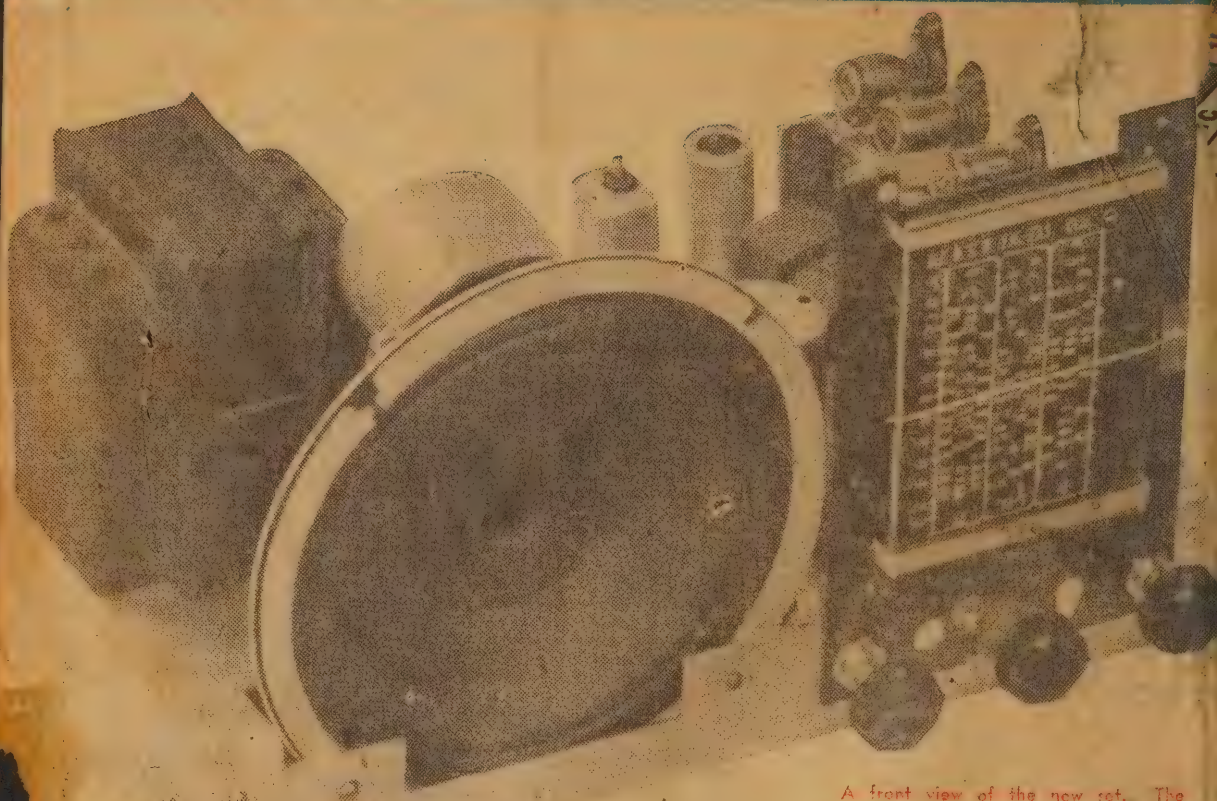


A front view of the new set. The controls from the left are; volume, tuning, and tone. The IF valve and the second IF transformer are just visible at the rear of the chassis. The chassis size and layout fits the recent Fireside Five cabinet.

green = good
Book RF.C

A 5-VALVE WITH A DIFFERENCE

Yes, this is a different approach to the problem of how to make the best use of five conventional valves. Having an RF stage in place of the conventional audio amplifier it is intended for country areas where the emphasis is more likely to be laid on low noise and high selectivity than on fancy audio systems. In fact, it's just about the ideal "second set" for a country home.

by Philip Watson

ONE reason why we designed this set was simply that we had received many suggestions and requests for such a circuit. For the most part they were from country readers who needed something rather better than the average four or five-valve receiver, but who felt that the more elaborate six to eight-valve designs were not justified, particularly for "secrials in the kitchen".

They suggested that it may be possible to make better use of five valves (four plus rectifier) if the audio stage was omitted and RF stage added in its place is quite sound reasoning there are a number of advantages to such a scheme.

For example, the RF stage makes a worthwhile improvement in sensitivity, something which an audio stage cannot do.

Furthermore, it improves adjacent channel rejection and minimises spurious heterodynes and whistles by rejecting strong and unwanted signals before they reach the frequency converter. If not rejected, these can easily produce what are popularly called "birdies".

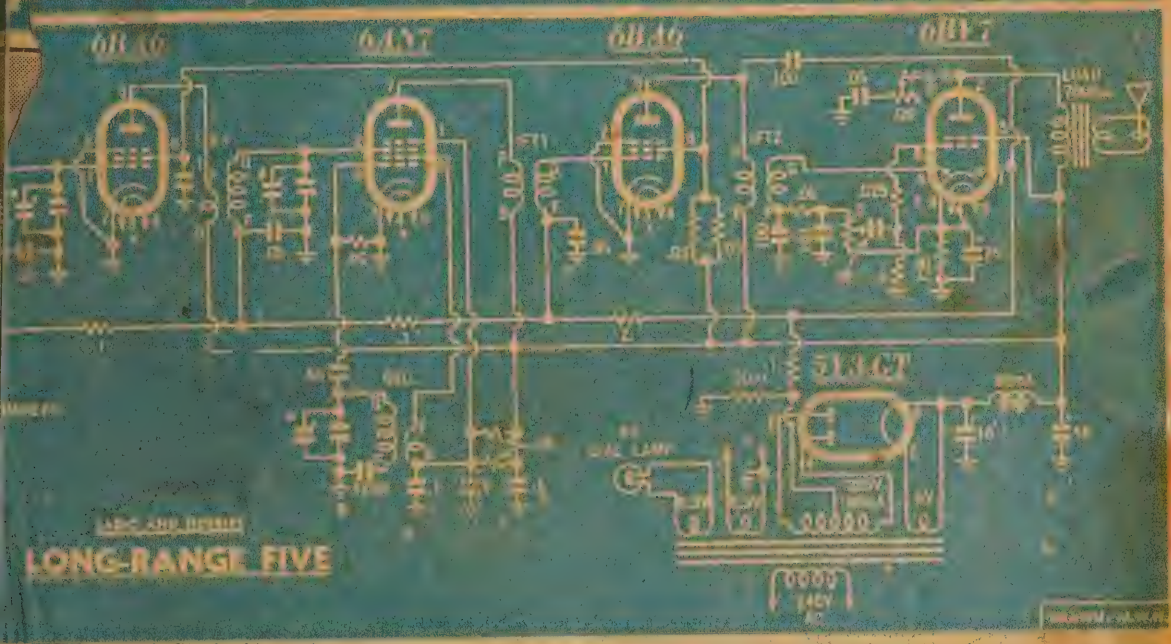
There is also the question of converter noise to be considered, when the best use is to be made of weak signals. In the normal way, a local signal is so many times stronger than this noise level that it is never a problem, but it can become obtrusive when the maximum sensitivity of the set must be used.

By lifting the signal level before it reaches the converter, as with an RF stage, the converter noise is made negligible in just the same way as it is with a moderately strong local station.

Obviously, therefore, it is possible to make a good case for employing a valve as an RF amplifier, rather than an audio stage, at least as far as listeners in not-so-good locations are concerned. We don't claim that this set is as good as one having an RF stage AND an audio amplifier, but it should be better than the conventional five-valve set.

So much then for the general picture. Let us now consider the circuit in greater detail. Since we wished to preserve the highest possible audio gain with a single stage we chose as an output valve the 6BV7. This is about the most sensitive power valve available, requiring only five volts of audio to drive it to full output. Since full output is four watts the signal re-

CIRCUIT EMPLOYS STANDARD R.F. FRONT END



...circuit employs a perfectly standard "front end" using a RF stage and the only difference is the absence of an audio stage. ...to particularly the AVC circuit which introduces more than the usual amount of delay for reasons mentioned in the text.

...d for average listening is like-...be nearer one volt.

...ther advantage of this valve ... presence of two diode plates ... same envelope, thus providing ...ies for detection and AVC. The ... system is particularly impor-... in a receiver of this type and ...nts some discussion in detail. ...t, all the gain concentrated in ...F and IF end of the set, and ...r the control of AVC line, it is ... possible to create a condition ...e the AVC severely limits the ...ut and sensitivity of the receiver. ...en in a normal receiver, the ... system of a set is deliberately ...ed so that it will not come into ...ation until a signal of a certain ...determined strength is received. ...is was not done, the noise level ...the atmosphere would be suffi-... to bring the AVC into oper-... before any signal was received, ... reducing the initial gain of ...receiver.

...RMALLY SMALL

...here a high-gain audio stage is ..., only a small delay voltage is ...ed, usually between one and ... volts, since the power stage ...n be driven to full output ... before signals of this strength ... applied to the respective diode ...its.

...wever, with an audio system of ...ively low gain it is better to ...ge matters so that the signal ...e diode builds up a larger figure ...re the AVC comes into oper-...

...this reason we modified the ...t somewhat and increased the ... voltage to a much higher than ... figure. Part of this volt-... provided by the self bias re-... of the 6BV7 which develops ... volts. If the AVC net-... returned direct to chassis this ... be the total delay voltage but ...ional voltage, as well as the re-quisite bias, is provided by the back-bias network.

We chose to use back-bias for the first three stages, in preference to self-bias because, by so doing, we saved five components—a worthwhile saving in terms of both economy and space. Happily enough, this also fitted in nicely with the idea of providing a high delay voltage by adding another two volts to the system, making a total of seven volts in all.

In practice this worked out very well, all available stations being able to produce more volume than necessary (or desirable) for a set of this size. There is no chance either that any weak station will be masked by AVC action.

The remainder of the circuit is fairly conventional. 6BA6's are used in the RF and IF stages, with a 6AN7 as the converter. A common screen dropping resistor is used for the two 6BA6's, while the 6AN7 screen and oscillator plate are also fed from a common dropping resistor.

It will be noticed that an 8 mfd electrolytic is shown dotted in the circuit at this point, and its purpose is to prevent a form of motor-boating known as oscillator flutter. In the original set there was a slight tendency to it when tuned to strong

PARTS LIST

1 Chassis 11 7/8" X 5" X 1½"
1 6" Speaker with transformer to suit 6BV7 (7000 ohms).
1 Dial SLV/21 or similar.
1 Power transformer, 285V, 80 mA, 6.3V, 2A, 6.3V, 2A, 5V, 2A.
1 60 mA Filter choke (see text)

VALVES
1 5Y3
1 6AN7
2 6BA6's
1 6BV7

1 Standard aerial coil.
1 Midget RF coil.
1 Midget Osc. coil.
2 Midget IF transformers (1st & 2nd.)

RESISTORS
1 2 meg ½W.
1 1 meg ½W.
1 .5 meg pot. with switch.
1 .5 meg. ½W.
2 .1 meg. ½W.
2 .05 meg. 1W.
2 .05 meg. ½W.
1 .05 meg. pot.
2 .03 meg. 1W.
1 .025 meg. ½W.
1 125 ohm 3W.
1 30 ohm 1W.

CAPACITORS
25 mfd. 40V electrolytic.
2 16 mfd 525V electrolytic.
1 8mfd 525V electroyltic (optional see text).
3 .1 mfd 350V paper.
1 .05 mfd 350V paper.
3 .05 mfd 200V paper.
1 .02 mfd 400V paper.
1 420 pf mica.
3 100 pf mica.
1 50 pf mica.
1 3 gang tuning unit.
3 trimmers.
1 dial lamp and socket.
2 2 terminal tag strips.
4 terminal tag strips.
1 5 terminal tag strips.
2 7 pin miniature sockets and shields
2 9 pin miniature sockets
1 octal socket.
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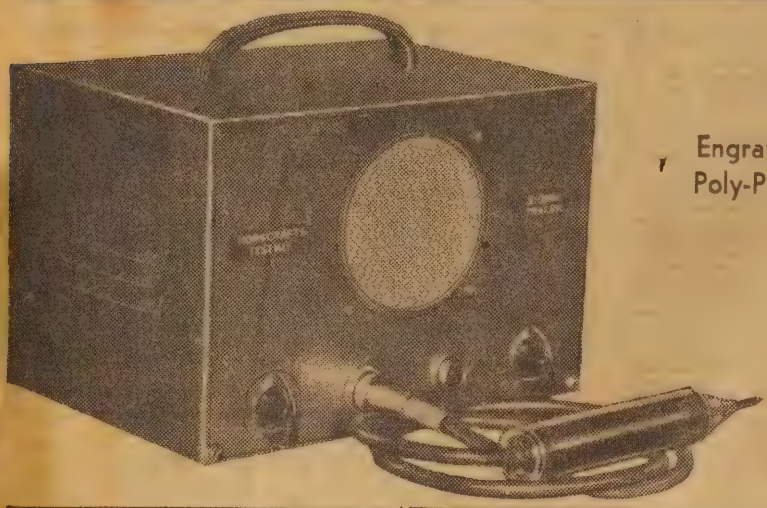

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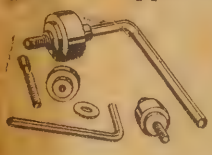

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KC.
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KC.
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struction of V
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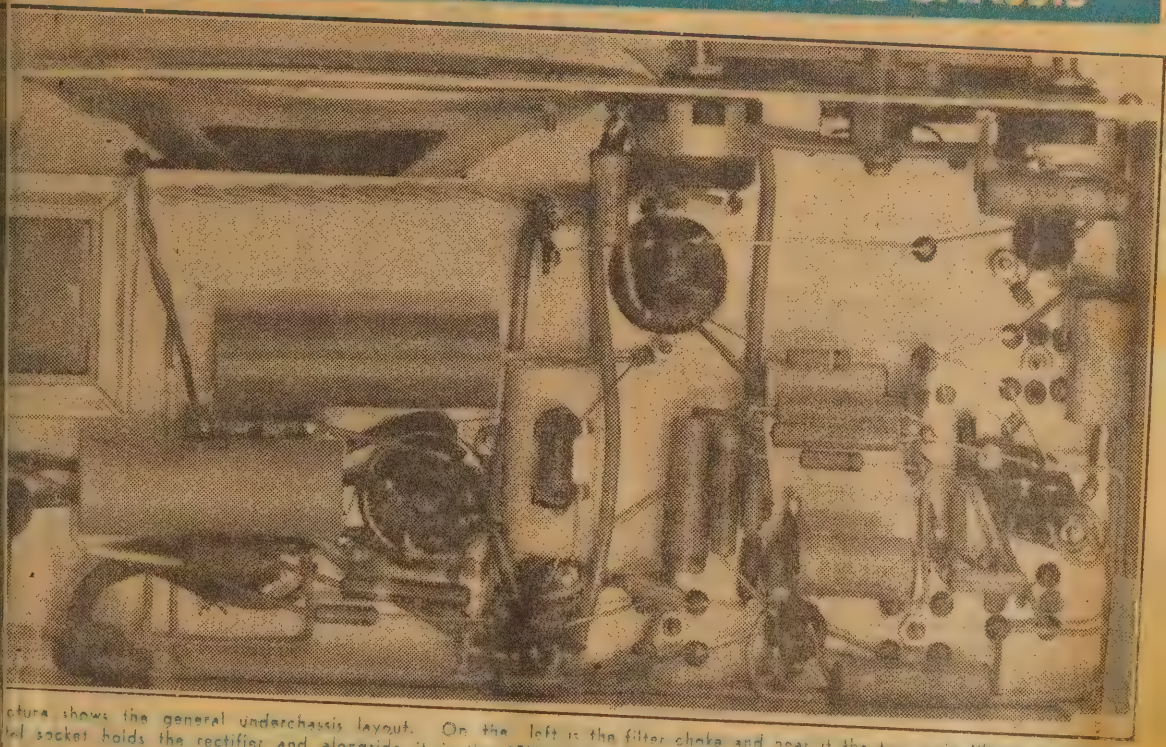

ture shows the general underchassis layout. On the left is the filter choke and near it the two main filter capacitors. al socket holds the rectifier and alongside it is the 6BV7 cathode by-pass. Note the use of tag strips to mount the minor components.

the low frequency end nd and with the volume ly advanced.

other part of the circuit comment is the power ince the current drain of ge is much higher than audio amplifier we found onventional 60mA trans- uld be pushed a little n desirable, the total drain something like 70 mA. nothing for it, there- use an 80 mA type.

IFIER

dered the use of one of pe indirectly heated rec- examination of the curves at we would probably ith more volts than re- ather than fit a resistor of this, we reverted to s characteristics are such T voltage came out to tly 250 volts.

lly, we should have mA choke also, but somewhat bulky, and to try the effect of a 60

, in terms of heat, is critical for chokes as it ormers, though it does he effective inductance However, since we were gain audio stage, fil- ot quite so critical and, he whole scheme work- nicely.

ome points about the uction. We decided that probably be most use- ntel set, though there objection to using it as so desired. The cabinet we recently designed for the "Fireside Five" appealed to us as being an ideal size for a set of this kind being large enough to house an efficient speaker, yet not so large that it cannot be moved from room to room if desired.

We also had ideas about using the Fireside Five chassis, or some other chassis, already designed, which would suit.

Unfortunately, this was not feasible, and no amount of juggling of components would permit us to use the existing holes without seriously prejudicing the performance of the set. There was nothing we could do but design a new chassis, having the same dimensions and major cut-outs as the Fireside Five, but with quite different placing of the components.

Along with the Fireside Five cabinet we have retained the same dial and speaker.

To accommodate all the components on this chassis, while retaining a desirable layout, we found it necessary to use the miniature series of coils and IFs. The exception is the aerial coil, and we chose to make this standard because it is difficult to retain the efficiency of an aerial coil in the miniature series. The added efficiency of the larger type is quite worthwhile in this part of the circuit.

SPEAKER MOUNTING

There is not a great deal of clearance between the power transformer and the loudspeaker and this point should be carefully watched if a transformer other than the one we used should be considered.

The orientation of the valve sockets, coils, and IF transformers is most important if the original layout is to be duplicated and, if this information cannot be readily obtained from the reproduced photographs, the following hints should help:

The aerial coil has its "earth" and "grid" pins toward the front of the chassis. The RF coil has it "B plus" and "plate" pins toward the edge of the chassis, while the oscillator coil has the same pins toward the rear. The first IF has the "B plus" and "grid" pins to the rear of the chassis and the second IF the "plate" and "B plus" to the rear.

SOCKET DETAILS

The 6BA6 RF valve has pins 4 and 5 nearest the edge of the chassis, and the 6AN7 socket has pins 3 and 4 in the same direction. The 6BA6 IF valve has pins 3 and 4 to the rear of the chassis and the same applies to the 6BV7 socket. The 5Y3 has pins 5 and 6 to the rear of the chassis.

Liberal use is made of tag strips to mount the various minor components and a good idea of their disposition can be obtained from the under chassis photographs. A four terminal strip is mounted near the 6SN7 socket and carries between its two end terminals a .1meg AVC resistor. The other terminal holds one end of the two .05 meg. dropping resistors.

Another four terminal strip supports these resistors at the other end, this terminal being a HT point. From this same point two .03 meg. run to the screen pin of the IF valve. The remaining terminals support one

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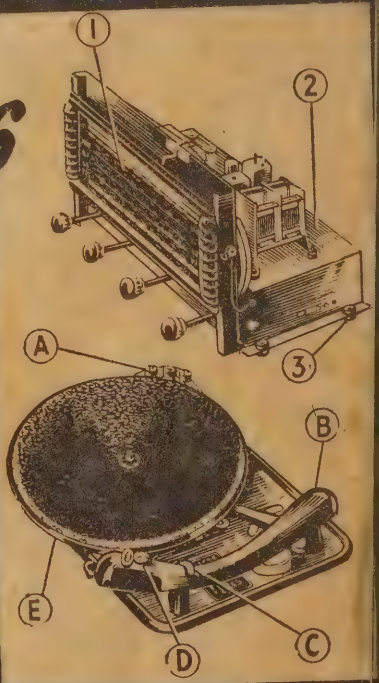

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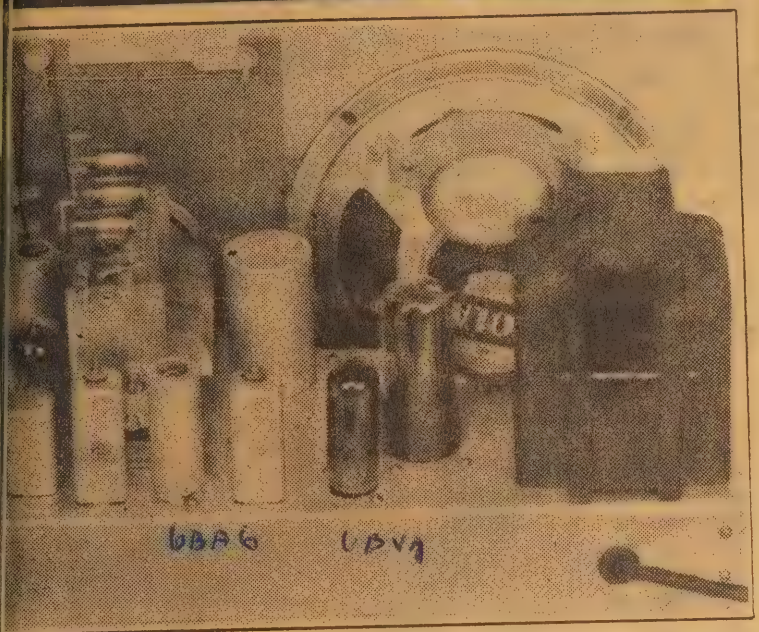
REAR VIEW OF THE CHASSIS



e placements of major components is clearly seen in this rear shot. Along the ft hand end of the chassis, from the dial, is the RF valve, the RF coil (just visible), e converter, and the oscillator coil. Along the rear is the 1st IF, IF valve, 2nd IF, output stage, and rectifier. The aerial coil is to the right of the gang.

of the 2 meg. AVC resistor, ter- ate one end of the .05 meg. diode upling resistor, and support one the 100 pf by-pass capacitors. ded cable runs from here to volume control.

two terminal strip is mounted r the volume control to hold the mfd coupling capacitor and an- er near the 6BV7 socket to hold .025 meg grid stopper. A fourth minal strip near the entry of the ver cord terminates the latter, well as providing support for 30 ohm back bias resistor.

WER SUPPLY

Between the two electrolytics, a ee terminal strip will serve to minate the choke leads and sup- t the positive leads from the elec- lytics. A five terminal strip near left hand edge terminates the mary leads of the transformer. twisted pair of hook-up wire runs ound the edge of the chassis to nnect the switch on the volume ntrol pot. to the appropriate ter- nals on the tag strips.

With all the major components ounted, consideration can be given the wiring. All the metal spi- ts of the valve sockets should earthed and while doing this is worthwhile considering other rth connections, which need to be ade at the same socket. In the se of the 6BA6's the cathode and ppressor also need to be earthed d one piece of tinned copper wire tween pins 2 and 7 will rest gainst the spigot to which it can soldered.

In the case of the 6AN7 pin three quires to be earthed, while the BV7 does not require any earthing part from the spigot. However, his is a good point to earth one de of the filament circuit.

Very short connections, as between the coil and valve pins, are most easily made using bare tinned copper wire. This is best straightened by stretching before using. For longer runs ordinary hook-up wire is best.

Several leads need to be of shielded cable, these being that from the diode decoupling network to the volume control, from the volume control to the grid circuit of the 6BV7, and from the plate of the 6BV7 to the tone control pot.

To prevent short circuits due to the metal shielding braid it is advisable to enclose this cable in insulating sleeving. Alternatively, insulated shielded cable, such as PT1M could be used.

In any case, connection to the shielding braid is most easily made by unravelling the braid for about half an inch or so, then twisting the strands together to form a lead.

With all the wiring completed, check everything over carefully and then make a preliminary test by switching on with all valves in their sockets except the rectifier. If all filaments light it is at least an indication that this part of the circuit is intact.

CHECKING THE HT

Next the rectifier should be plugged in and the power switched on while watching the rectifier for signs of distress. In the event of sparks or blue flashes switch off immediately and check for HT shorts.

It is also a help if a meter can be connected across the HT supply before it is switched on, since this will give an immediate indication of trouble. Normally, the voltage should rise almost immediately to about 300, then slowly settle back to about 250 as the other filaments warm up.

The voltage across the 6BV7 bias

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Magnetic
Recorder Tape
MC III 1,200ft x ¼in
52/6 per reel
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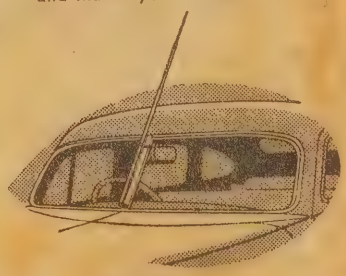

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Obtainable from all leading Motor and Radio Accessory Wholesalers and Retailers
WA5

MAN Man Electrocuted Repairing His Ca

BRISBANE

ELECTROCUTED!

car on ... Neighb... death ... short-circuit... and ambulance ... vainly applied artificial respiration. ... leaves a widow and three children.

... an extension ... switch on his front ... ead to the

A newspaper recently reported that a mar was electrocuted whilst repairing his ca with the aid of an extension light . . . He plugged in a lethal 240 volt extension lead to the switch on his front ver- andah and was holding the light. "Police say a short cir- cuit caused his immediate death." This is just one of many similar tragedies that could have been prevented with the—

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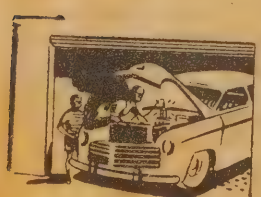

MOTORISTS

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esistor should be approximately five nd across the 30 ohm back bias re-istor approximately two.

The 6BA6 screens should measure pproximately 100 volts on the 1000-olt scale of a standard multimeter, nd the 6AN7 screen and oscillator late should measure about 70 volts nder similar conditions. All these neasurements should be made with he aerial disconnected and the set uned off a station.

Assuming that all is well with regard to voltage the set should show some signs of life and tuning over the band should at least produce the local stations. However, it is possible for the coils, as purchased, to be quite wide of the mark and performance can be very poor until they are brought into line.

This is particularly so since there is one more stage than usual to attenuate the signal if it is out of tune.

OSCILLATOR DESIRABLE

Since the set is intended for weak signal operation correct alignment becomes virtually essential; much more so than a receiver intended for local station reception only. For this reason we suggest that you beg, borrow or steal an oscillator and do the job properly. Alternatively, pass the job over to someone who has the necessary equipment and skill to do it for you.

It is possible to achieve some measure of success working by ear, but it is extremely unlikely that best results will be obtained. The main reason for this is that most of the gain of the set depends on the correct operation of tuned circuits, as distinct from the more conventional sets where the audio amplifier stage will provide its share of the gain without any adjustment.

A pamphlet detailing standard alignment procedure is available through the 2/- query service.

FILAMENT WINDINGS

Finally, a point about the transformer filament windings. Most 80 mA transformers are fitted with two 6.3 volt windings rated at 2 amps each, the assumption being that most sets drawing 80 mA of HT will probably have five or six valves, and, therefore, likely to need this amount of current.

In this case the drain is well within the limits of a single winding, even allowing for .3 amp for a dial lamp. If you decide to run everything from the one winding the unwanted leads should be well-taped and tucked out of the way, inside the transformer housing if possible.

Alternatively, as we have shown it in the circuit diagram, the spare winding may be used to operate the dial light, and there is a slight advantage in this arrangement. Mainly it concerns the possibility of shorts to frame from the dial lamp-holder (this is quite a common fault with some types) and the chance to avoid it by operating the entire dial lamp circuit free from any chassis connection. In this way trouble is avoided if either side of the circuit should accidentally "frame".

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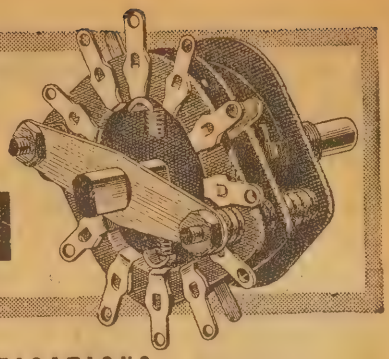
(Pat. App. 15243/53)



SPECIFICATIONS

MAX. OPERATING POTENTIAL —1,000 V.

CONTACT RESISTANCE — 800 Micro-Ohms.

TEMP. RISE ON CONTACTS:— (with 10 Amp. Conductors)
at 10 Amperes 10° rise
at 20 „ 30° „
at 30 „ 50° „

BREAKDOWN VOLTAGE:—
A. Between adj. contacts, 3,000 V.
B. Contacts to earth, 3,000 V.
C. Between O/c. contacts, 3,000 V.

RATING—10 Amp., 250 V.A.C.

CONTACTS—Silver-plated Copper. Non-shorting only.

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1 Pole—max. 12 contacts
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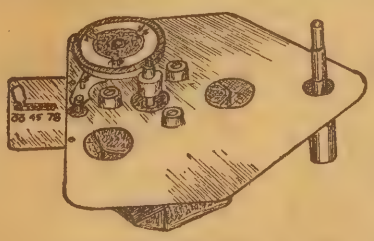

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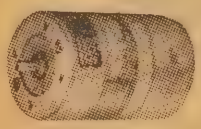

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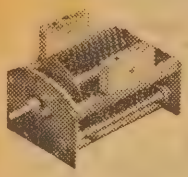

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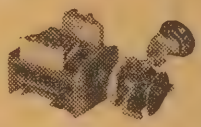

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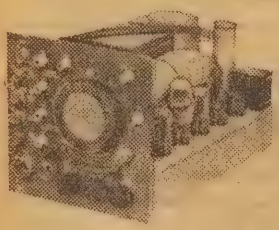

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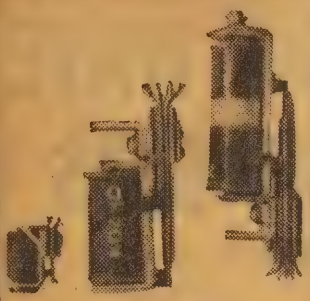

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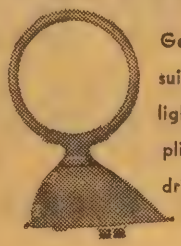

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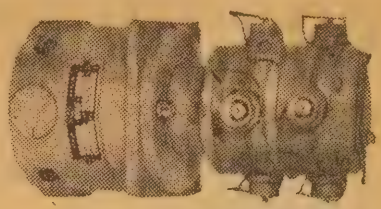

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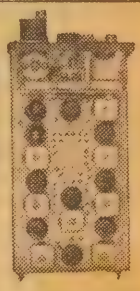

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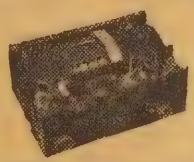

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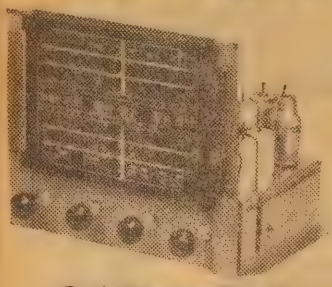

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6K7G 8/6	1K5 .. .. .. 7/6	

Please add postage

New Electrolytic Condensers

8 MFD-525V **3/6** each or **34/-** dozen plus post.
8 MFD-350V **2/6** each or **24/-** dozen plus post.
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12 MFD-600V **4/9** each or **48/-** doz. plus post.

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METROPOLITAN RADIO SUPPLIES

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(At top of Taverner's Hill)

PHONE LM3610

NEW VALVE SOCKETS

Teleton 8-pin octal moulded sockets **5/-** per dozen or **25/-** per 100.

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Well known make of carbon resistors in values of 100 ohms to 5 megohms. In 1-watt, ½-watt and 1/3 watt. All resistors are standard color coded and in original cartons. In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt, 25 1/3-watt. .. Post, 1/6.

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IN LOTS OF 500, 50/-.

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English multi-core solder in 1lb reels.

12/6 per lb.

Postage extra

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RECORD-CHANGER CLEARANCE

100 SINGLE SPEED RECORD CHANGERS IN GOOD ORDER. INCLUDING GARRARD, H.M.V., OAK, COLLARO, STROMBERG-CARLSON.

ALL ONE PRICE **£6/10/-**

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NYLEX HOOK-UP WIRE AT HALF PRICE

Nylex hook-up wire 10/.010 in 100 yard coils, each coil consisting of five 20 yard lengths in 5 different colours.

10/- PER 100 YDS. Plus postage

WILL RADIO, LIGHT WAVES MEET?

Since the earliest days of radio, the exploration of frequencies higher than those in common use at the time has provided an exciting field of endeavor for the scientist and experimenter with pioneering instincts.

STRANGELY enough, such efforts have almost invariably been ridiculed and condemned to failure by the contemporaries of such "explorers". And, just as unfailingly, the ultimate results have usually proved the sceptics to be wrong and the new portion of the radio frequency spectrum has always turned out to be of extreme value in extending the art of radio communication.

Even before World War I, in the days of spark transmission, the radio amateur fraternity were relegated to the region "200 metres and down" because this portion of the spectrum was considered virtually worthless for communication purposes by the professional engineering world.

NEW FIELDS

However, when the "hams" demonstrated that transoceanic contacts were easily accomplished on the unheard-of wave-length of 100 metres, these same commercial interests flocked to use the new "short waves".

Needless to say, this region now contains almost all of the valuable communications channels now in use.

The adventurous experimenters didn't stop at 100 meters, or even 50 meters, however. They pushed the revolutionary new vacuum tube oscillators and receivers all the way down to about 20 meters.

Again, this "radio no-man's-land", which had been thought to be worthless, had, in a short while, demonstrated a new phenomenon in communication — long-distance signals over a daylight path. This started another rush for new channels, and today these frequencies are highly prized for international broadcasting and communication.

This downward migration, spearheaded by the amateur and experimenter, ground to a halt below 10 meters, where it was found that radio signals were not reflected back to the earth by the ionosphere much of the time, making communications beyond the horizon doubtful.

For a long while these line-of-sight VHF frequencies remained unexploited because of these limited propagation characteristics and the fact that conventional vacuum tubes of that era would not operate efficiently at such elevated frequencies.

Transit-time effects, excessive lead inductance and high losses in the base materials used limited their performance. Little effort was expended in developing improved tubes and circuits since few people had enough vision to see that such short-haul radio might be extremely valuable for local services like police radio, where the line-of-sight characteristic would give freedom from interference by similar services in distant cities.

Here again, however, a few intrepid experimenters, with an eye on the vast reaches of unused megacycles stretching into the VHF region, persevered.

They removed the lossy bakelite bases from the available tubes and developed "long-lines" circuits to minimise the effects of tube element loading.

HIGH GAIN AERIALS

They spent long hours policing unused frequencies looking for someone with whom to communicate. They learned to make multi-element, high-gain antenna arrays compensate for the low powers available from the tubes at hand.

Even as late as 1940 a "ham" experimenter engaged in such pursuits was likely to be considered more than slightly demented by his fellow amateurs, who maintained that he was wasting his time with "backyard" radio when he could communicate across the world by going a few megacycles lower.

In the end, however, these "die-hard" experimenters had pioneered the VHF bands and had laid the groundwork for the techniques now employed in the transmission and reception of television, FM, police radio and many other services.

These frequencies now include the most commercially important megacycles in the entire radio frequency spectrum.

Unquestionably, the most rapid advance in the exploration of the spectrum was made during the period of World War II, when the upper limit of efficient radio frequency generation was extended at least 100 times in a few short years. The impetus, of course, was the development of radar.

At the start of this period, the conventional triode had reached its limit of practicality at about 600 megacycles. From the early "audion" it had been "scaled down" to the size of the familiar acorn tube.

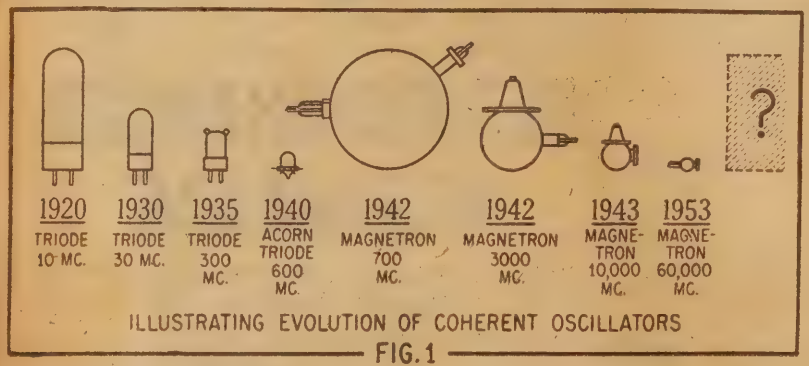
This reduction in size was necessary to keep interelectrode capacitance small so that the external circuit would not be reduced to a short between the grid and plate. It was also necessary to space the tube elements extremely close to reduce transit time effects.

LOW DISSIPATION

The result of this size scaling is to greatly reduce the power generating capabilities of the tube, since the small electrodes can only dissipate a small amount of heat.

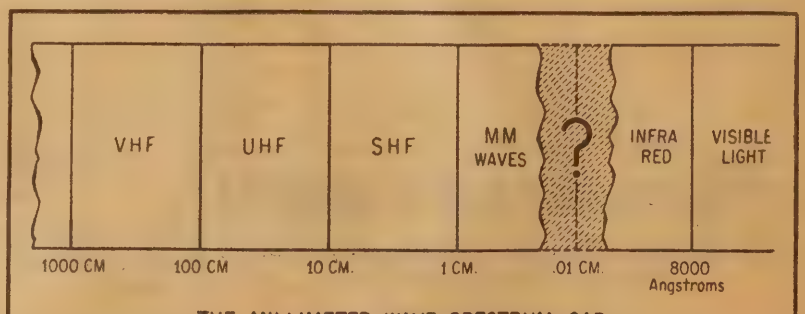
The need for a source of powerful centimetre waves for radar led to the development of the microwave magnetron and klystron tubes. These made the extension of the state of the art mentioned above possible because, unlike the triode, their dimensions are comparable to the wavelengths generated.

Thus, a magnetron for 600 megacycles was many times larger than a triode for the same frequency, and could dissipate proportionately more power. However, as the microwave



ILLUSTRATING EVOLUTION OF COHERENT OSCILLATORS

FIG. 1



THE MILLIMETER WAVE SPECTRUM GAP

FIG. 2

tubes have been scaled to progressively higher frequencies, the size of their critical elements have decreased accordingly.

The result is that the magnetron and klystron have encountered, at around 60,000 megacycles, the same kind of limitations reached by the triode in the 30's. Their size and element tolerances and spacings have become comparable to the acorn tube — and their power handling capabilities not much better.

The evolution of radio frequency generators discussed above is illustrated in Fig. 1, which shows relative size comparisons. It is obvious from this presentation that a new principle is needed to extend the useful limit of generation further into the millimetre wave region.

Scientists and physicists interested in spanning the gap which exists between the long infra-red part of the spectrum and the radio frequency portion (see Fig. 2) have long sought this new principle.

NEW APPROACH NEEDED

Figure 1 indicates that a successful generator for the millimeter wavelengths will probably have to be much larger in dimensions, compared with the waves generated, than the magnetron and klystron are. To date, the approaches used in the generation of such extremely short waves have had this property. We will now discuss some of these.

Most of the radio frequency sources, except the early spark transmitters, are coherent generators.

A coherent generator is one which emits a wave train having a single (or monochromatic) frequency of a single and sinusoidally varying phase. An incoherent source, on the other hand, is one which emits energy over a band of frequencies consisting of numerous wave trains of various phases and amplitudes.

Wave trains of these two types are compared in Fig. 3. Examples of incoherent sources are hot bodies which emit visible light or infra-red waves, and the spark transmitters mentioned above.

The type of generator employed in attempts to span the gap between light waves and radio waves in the past has usually depended upon the background of the researcher.

Physicists, trying to extend the long wavelength limits of their light sources for spectroscopy, have pushed into the long infra-red region with incoherent generators, while engineers have scaled coherent oscillators down to a few millimetres from the radio side.

FIRST ATTEMPTS

The first successful millimetre generators were incoherent sources utilising the spark discharge principle. There were essentially scaled-down versions of the early long-wave spark transmitters, which consisted of a resonant circuit excited by a spark discharge.

It will be recalled that a circuit of this kind generates a "damped" wave because the spark shock-excites the resonant circuit which then oscillates until the circuit losses cause the oscillator to die out, or decay.

A good example of a millimetre source using this principle is Lebedew's generator, built in 1895. See Fig 4. In this simple arrangement a spark discharge produced by a high-tension induction coil is passed through a gap between two resonant

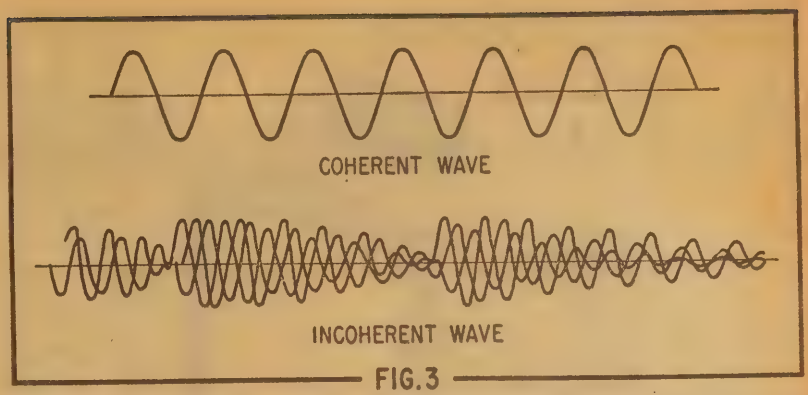
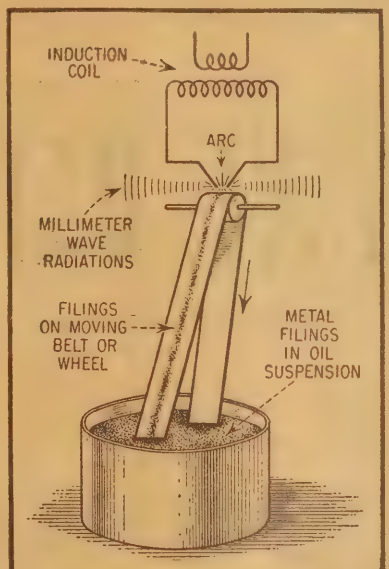


FIG.3

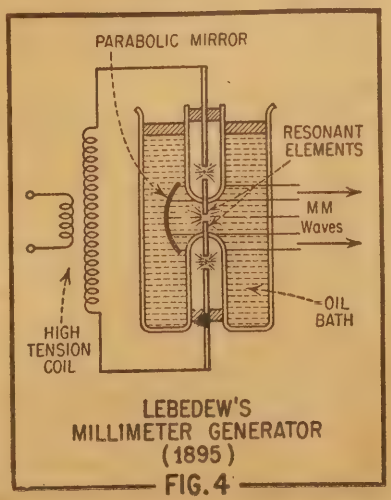
elements immersed in an oil bath. A parabolic mirror focuses the oscillatory energy thus produced in the desired direction. The oil bath serves to cool the resonant elements.

The wave-length generated is determined by the physical size of the spark-gap elements; incoherent waves as short as .22 millimetre have been generated by this method.

A similar form of incoherent millimetre wave generator has been



MILLIMETER GENERATOR OF MASS RADIATOR TYPE
FIG.5



LEBEDEW'S MILLIMETER GENERATOR (1895)
FIG.4

known since the early 1920's. This machine, classified as a mass radiator, is illustrated in Fig 5. It consists of a sort of conveyor belt which carries metal filings suspended in oil from a reservoir up through a spark gap where a high-tension spark is passed through them.

Here again the mechanism is similar to that of the old spark transmitter and is closely related to Lebedew's generator, except that the spark is passed through a large number of metallic particles, which radiate at the same time. The radiations produced are far from monochromatic because of differing metallic particle sizes and the inherently low "Q" of the radiators.

This renders the mass radiator inadequate for the purposes of spectroscopy required by physicists since the large spread in frequency reduces the resolving power of the instrument.

More recent attempts to generate millimetre waves by incoherent means have consisted of impinging charged ball-bearings or atomised mercury droplets on a metal plate, and similar schemes. All such methods suffer from low-power generating ability, frequency dispersion and difficulty in utilising the energy because it is radiated in all directions.

PRESENT LIMITS

To date the only successful coherent millimetre wave generators are scaled-down versions of the magnetron and klystron. As discussed above, both of these are approaching their ultimate limits a little below 5 millimetres wave-length.

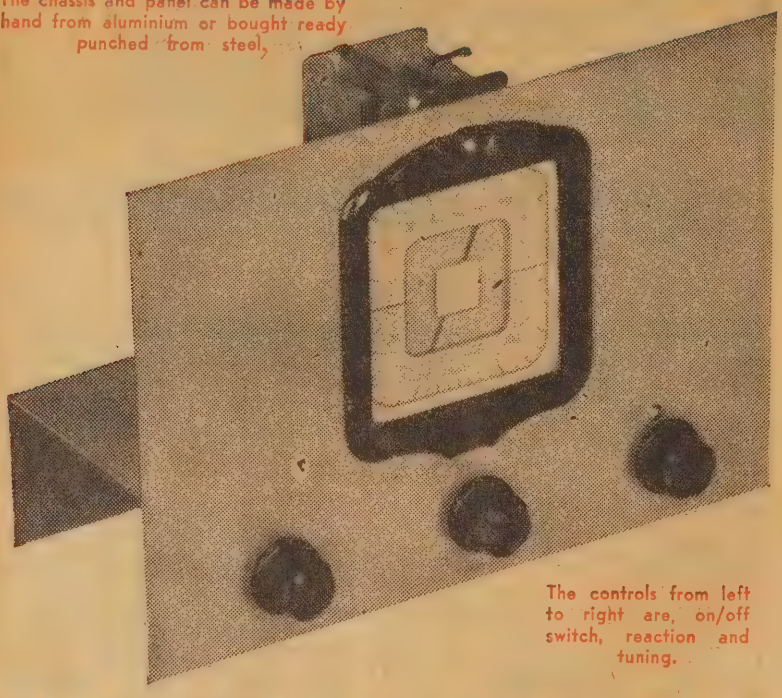
Here the efficiency of the magnetron, normally of the order of 50 pc in the centimetre range, has fallen to only a few per cent and that of the klystron is much lower. The powers available are only a few kilowatts pulsed or a few milliwatts continuous wave. The prospects of reaching substantially shorter wave-lengths are remote. New principles will have to be evolved.

Many of the new devices which have been proposed for millimetre wave generation are cloaked in military security. Most are so large compared with the wave-length generated and so inefficient as to make practical usage outside of the laboratory highly improbable.

One reason for the ponderous size of some of these schemes is the dependence upon "relativistic" electrons, ie, electrons accelerated to velocities near that of light. Equipment to achieve such velocities is inherently complex and cumbersome.

The question naturally arises as to what possible applications millimetre

(Continued on Page 79)



The chassis and panel can be made by hand from aluminium or bought ready punched from steel.

The controls from left to right are, on/off switch, reaction and tuning.

THE ALL-WAVE BATTERY TWO

Our latest two-valve receiver is designed for use on all normal short-wave bands, as well as the broadcast band. It will give excellent headphone reception in all districts with a possibility of loudspeaker results from the stronger stations. The set is completely independent of the power mains, a feature of value to many young city enthusiasts and essential to those in the country.

THERE has never been any doubt about the popularity of small regenerative sets with our younger readers. Quite a large number have been described and each has been a winner.

The usual formula is a simple regenerative detector, followed by audio amplifier, to give a bit of extra lift for the weaker stations.

A mains-operated version of such a receiver can be made with a twin triode, so that it is only necessary to purchase the one valve for both functions. Some of the earlier sets used the twin triode type 6A6 or its octal based equivalent, the 6N7. The 6SN7-GT, also, which has slightly different electrical characteristics, and the modern miniature types, like the 12AT7, may be used in the same way.

TOO MUCH FOR BATTERIES

All these valves are indirectly-heated types, which means that the filament power consumption is too great to allow them to be operated economically from batteries. However, a small filament transformer can supply the heating current and to avoid the complication of an AC operated high tension supply, a 45-volt battery may be used instead.

For those requiring an all AC-operated job, we described a version using a rectifier in addition to the twin triode in the May and June, 1953, issues.

The directly heated twin triodes types 19 and 1J6-G made possible a battery version, which was extremely popular. The two valves are electrically equivalent and, although designed to operate with a 2-volt filament supply, will usually do a good job in this type of set with a couple of torch cells in parallel to operate the filaments.

For anyone who would like to build a small set with a 19 or 1J6-G, we can supply circuits, &c., through the normal 2/- query service.

However, these valves are now losing favor to the miniature 1.4 volt series and the latter must be considered as standard for any future designs. The difficulty is that there is no readily available twin triode in the 1.4 volt miniature series.

The nearest we can get to the original "Little Jim" idea is a two-valve set using the pentode types 1T4 and 3V4. There is an extra filament to worry about and a couple of extra screen connections, but these are not likely to put you to any serious difficulty. For the extra trouble you are rewarded by better performance, because both valves are capable of comparatively high gain.

We can vouch for the reliability of the electrical circuit, because a very similar arrangement was used in a two valve receiver described as part of the "Teach Yourself Radio" series recently.

A 1.4 volt miniature pentode type 1T4 is used as a regenerative detector. Regeneration is controlled by a miniature capacitor rather than a potentiometer. It affords a particularly smooth control and will not deteriorate with use. Resistance-capacity coupling is used to transfer the audio signal to the 3V4, where it is amplified and passed on to the headphones.

NO DC THROUGH PHONES

The output circuit includes a load resistor and blocking capacitor and no direct current passes through the phones. You can even use crystal phones if you happen to have them. The 1.0 meg. resistor is included to discharge the coupling capacitor, so that an unpleasant click will not result when the phones are plugged in.

Battery requirements are modest enough not to embarrass even the most limited income. A 1.5 volt dry cell is required for the filaments and a 45 volt battery for the high tension.

The current drawn by the filaments is only 150 mA, so that even a torch cell will give a reasonable life. For most economical running, a small "A" battery of the type used in portable receivers is a better proposition. Similarly, "B" battery current is a mere 2 mA, and long life can be expected from even the smallest 45-volt battery.

DANGER OF SHOCK

This is a worthwhile point for some of our younger readers living in the city, because parents are not always keen on free use being made of the power mains for experimenting.

While this is not intended as a theoretical article, there are doubtless plenty of readers who will benefit by brief explanation of the regenerative circuit and some hints on how to get the best out of it.

The electromagnetic waves radiated by the radio station cause electric currents to be generated in the receiving aerial. These electric currents flow in the primary of the aerial coil of the receiver. The aerial coil transforms the energy from the aerial into a signal voltage, which is then

applied to the grid of the detector valve.

The function of the detector is to extract the intelligence (speech, music, &c.) from the carrier wave. After all, we are only interested in the carrier wave because it allows intelligence to be transmitted over great distances.

In this set the detector function is performed by the grid and filament of the 1T4 valve. Together they behave as a diode.

However, the grid, in conjunction with all the other elements of the pentode valve, behaves also as an amplifier. The "detected" audio signal is therefore amplified and a much stronger signal appears across the load resistor in the plate circuit of the IT4. It is passed on to the next valve via a coupling capacitor.

AMPLIFIES RF ALSO

However, as well as the audio signal, the 1T4 valve amplifies the RF signal, which also appears at the plate. So that the audio output valve can work at best efficiency it is desirable to prevent the unwanted RF signal getting past the plate of the 1T4. This is done by placing an RF choke in series with the lead and a small bypass capacitor on the output side of the choke.

The function of the choke is to allow easy passage of the audio frequency signal but prevent the RF signal getting through. The 250 pf bypass capacitor makes doubly sure that it does not get to the grid of the 3V4 by offering an easy passage to earth for RF signals. The capacitance is too small, however, to have appreciable effect on audio signals.

Actually, some of the radio frequency energy from the plate on the 1T4 can be put to good use in another way. It is fed back into the grid circuit and amplified again by the valve.

If this process were allowed to continue uncontrolled, the radio energy would gradually build up in strength until it eventually reached a stage where it would generate a signal on its own account, regardless of the signal coming in from the aerial.

NOT WHAT WE WANT

This is all very well if you wish to generate a signal but, at the moment, we are mainly interested in making best use of the incoming signal from a radio station.

A controlled amount of feedback, however, increases the effective amplification of the detector. Thus, a gradual increase in feedback will be found to result in an increase in amplification, until the feedback is increased to the point where the detector is just on the point of maintaining its own oscillation.

At this point there is a remarkable improvement, not only in the amplification, but also in the ability of the detector to differentiate between the desired signal and unwanted signals on nearby frequencies.

The reason for the improvement is that the energy fed back into the tuned circuit makes up for the energy lost in the coil, due to the resistance of the wire and other causes. In effect, the tuning coil is made highly efficient.

The adjustment required to maintain the detector on the verge of oscillation is critical and it is necessary to have a special control for the job. Since the amplification of the set varies with its setting, the regeneration control can also do the job of a volume control.

There are several ways in which the feedback can be varied. A number of them involve a potentiometer to vary the voltage applied to one of the valve electrodes. However, experience over the years has led us to believe that a method using a variable capacitor is to be preferred in the interests of maximum gain.

A coil, coupled to the tuned coil, is wired between the plate of the detector valve and earth, but in series with the small variable capacitor. With this arrangement, the current flowing through the reaction coil and hence the energy fed back into the grid coil can be varied by altering the setting of the capacitor.

The capacitor used for the purpose is much smaller than the tuning capacitor, with a maximum capacity of only 100 pf. The number of turns on the feedback winding are adjusted so that the circuit goes into oscillation before the maximum value of the small variable capacitor is reached.

A number of factors may act to vary the setting of the reaction capacitor needed to bring the circuit on the verge of oscillation. One of these is frequency. Over each band a different setting of the control is required for different stations.

Then again, as the frequency is increased it becomes increasingly difficult to get sufficient feedback, because the efficiency of the valve as an amplifier decreases. This places a definite limit on the maximum frequency at which the regenerative detector can be used efficiently.

The aerial is closely coupled to the tuned circuit, so that it absorbs some of the energy fed back from the plate of the detector. The setting of the control is therefore dependent to some extent on the type of aerial you are using. We have more to say about this in the discussion on the coils.

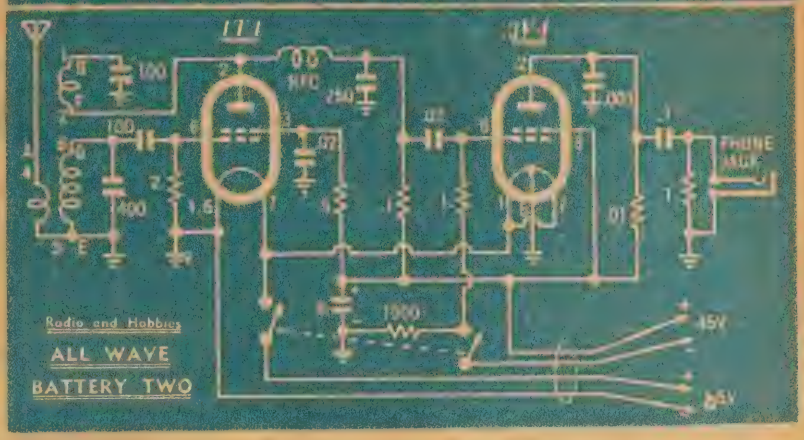
MINIMUM REACTION

When you are trying the set on any band for the first time, start with reaction capacitor plates fully out of mesh and vary the setting of the tuning capacitor. You will probably hear some stations, even if only weakly.

Tune so that the station you want comes in as loud as possible. Then gradually turn the reaction capacitor so that the plates come into mesh.

The volume of the station will increase as you do this, and, if you now

ALL-WAVE BATTERY TWO CIRCUIT



We predict that the circuit will be our standard arrangement for a long time to come. Performance is excellent and all parts can be bought over the counter.

PARTS LIST

1 chassis 8in x 4in x 2in.
1 panel 9in x 6in.
1 single section tuning capacitor, 400 pf max
1 miniature variable capacitor, 100pf max.
1 cord drive dial.
1 1T4 valve.
1 3V4 valve.
4 plastic coil formers, 1¼in diam.
1 pie wound RF choke.
1 phone jack.
3 knobs.
2 7-pin miniature valve sockets, with shields.
1 6-pin valve socket.
1 2 hole 2 position switch
2 terminals.
1 8 mfd electrolytic, 150 PV or higher.
1 .1 mfd paper, 400V
2 .02 mfd paper, 400V.
1 .001 mfd mica.
1 250 pf mica
1 100 pf mica.

RESISTORS

1 2.0 meg, ½watt.
2 1.0 meg, ½watt.
1 .5 meg, ½watt.
1 .01 meg ½ watt
1 1500 ohm ½watt.

SUNDRIES

Hook-up wire, 2 tag strips, battery plugs (if required), 3/8in rubber grommet, spaghetti, solder lugs, nuts & bolts etc.

You can easily change Worn Needle Styli yourself!

PICKUP IDENTIFICATION

★ For Standard "78" Records only:

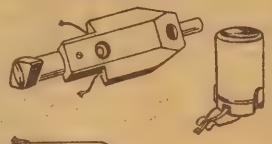
Group A:
Magnetic and crystal pickups using needle screws.

★ For Standard "78" and L.P. Records:

Group B:
Light weight pickups using miniature needles of push-in type.

Group C:
High fidelity pickups with styli as integral part of their construction.

Group D:
Crystal and magnetic cartridges using push-in cantilever styli.



Group E:
Crystal cartridges with screw-in cantilever styli.

● *All styli are available* for standard marked *Green*, for L.P. (Microgroove) marked *Red*. *The only exception is the No. 150 stylus*, where standard is marked *Blue*.

- **Prevent Record Wear . . . Enjoy Better Reproduction and Less Surface Noise!**
- **REPLACE STYLI regularly with the correct GOLDRING Replacement**

A good quality sapphire needle stylus, as incorporated in the equipment of reputable manufacturers, should survive many hundreds of playings for standard records, and at least one hundred playings for LP records before wear causes damage to records and inferior repoduction.
But such life expectancy can be substantially reduced. Faulty, chipped or dust-laden records can have disastrous results. The weight, damping and tracking of your pick-up affect the rate of wear. And, most important, the method of handling (gentle or otherwise) either manually or by the record changer.
Safeguard your valuable records ... the cost of regular stylus replacement is negligible in comparison.
DANGER SIGNALS
Standard Records. Black dust accumulating on needle point and increased surface noise.
LP Records. Fine thread or fluff at needle point and discolouration of grooves.
You can easily change the needle stylus yourself. Read the identification details and fitting instructions. All leading retailers stock "Goldring" replacement styli.

NEEDLE IDENTIFICATION

Check for detail only . . . needles are NOT shown in actual size.

GROUP			
A	S/1	S/6	S/1 is recommended for light crystal pickups. S/6 for record changers and both crystal and magnetic pickups, minimising record wear.
B	S/3	150	S/3 for Connoisseur, Goldring 121, 122, H.M.V. and other light weight pickups. 150 for Goldring 3-way pickup. *Blue* stylus for Standard. *Red* for L.P.
C	★ Styli, being an integral part of pickups in this group, cannot be supplied. New styli will be fitted at moderate cost by Goldring Service Department, 57 H.E. Area, *ST. MARYS, N.S.W.* Please take cartridge to your retailer, who will make necessary arrangements. The best known pickups in this group are the *Goldring Headmaster* and the *Decca magnetic* pickup. In the case of the latter it will be sufficient for armature to be sent in to effect styli replacement.		
D	S/8	S/9	S/8 for BSR. record changer. S/9 for various Acos cartridges. The main difference between S/8 and S/9 is length and angle. As the angle cannot be re-set watch this point carefully. S/9 used by Collaro, Garrard, Acos and others. S/10 for Goldring Magna cartridge No. 200. S/11 for Plessey Changer. S/12 Garrard "Astatic" U.K. S/13 Garrard "Astatic" U.S.
	S/10	S/11	
	S/12	S/13	
E	S/7		S/7 used in *Goldring turnover* pickup, *BSR. unit* GU-4, *Stromberg-Carlson* changer, *Garrard* changer, *Acos* pickup, etc.

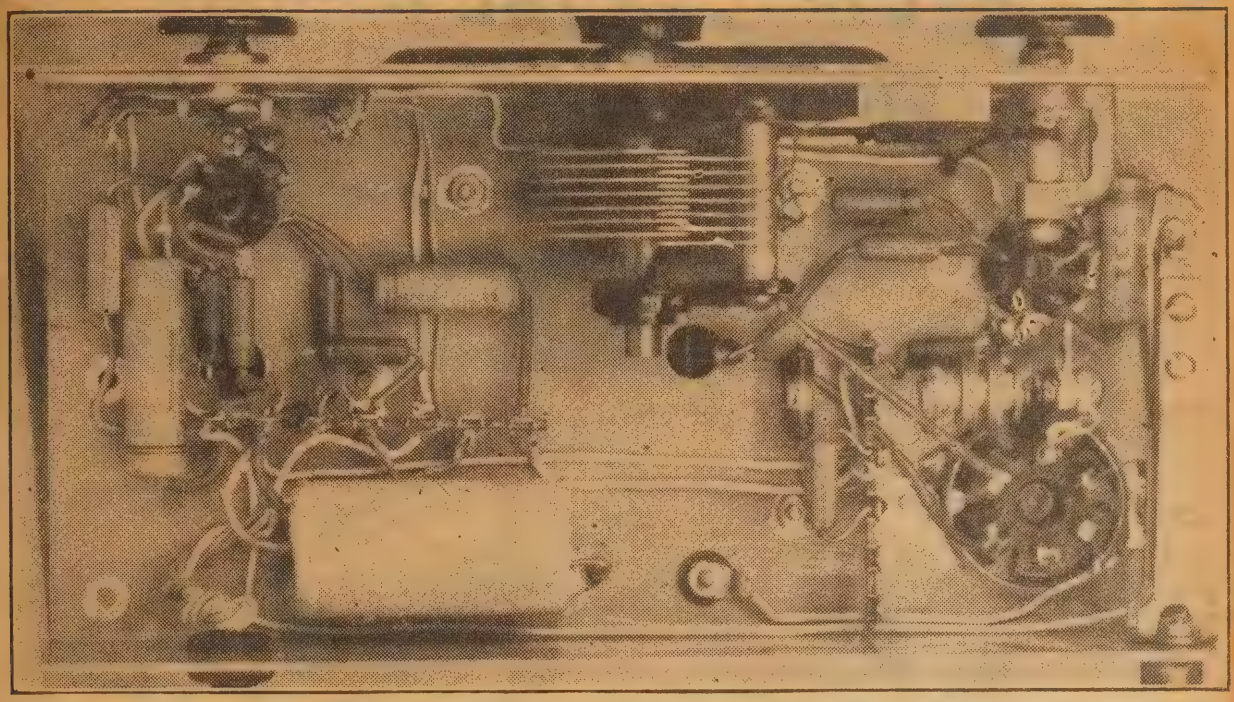
You can easily change styli yourself. A small screwdriver and a small pair of flat pliers are the only tools required.
First identify the PICK-UP GROUP from chart above; then further check against the STYLUS REFERENCE CHART at left.

FITTING INSTRUCTIONS

GROUP A: No tools required.
GROUP B: Styli to be inserted without side pull or bending. It is important for needle point to be perfectly straight over record.
GROUP C: Styli replacement by Goldring Service Dept.
GROUP D: Withdraw old needle styli by gentle but straight pull and insert new styli without using force in the same manner. Using force would damage pick-up mechanism as well as possibly snap off cantilever of stylus. If cartridge is inaccessible for effecting styli change while cartridge is in position, it can easily be removed in all cases by unscrewing cartridge from pick-up arm.
GROUP E: Turn cartridge until styli holding screw in centre of cartridge shows. By unscrewing it, both styli can be withdrawn simultaneously and new styli inserted, making sure the flats of these go inside.

GOLDRING ENGINEERING (Australasia Pty. Ltd.)
57 H.E. AREA, ST. MARY'S, N.S.W.

UNDERNEATH VIEW SHOWS COMPONENT PARTS



This photograph, which is almost full size, shows how the set should look underneath when the wiring is complete. Compare it with the wiring diagram on page 75.

check on the setting of the tuning capacitor, you will find that it has shifted slightly. A few minutes' practice and you will be able to tune the set very accurately in a few seconds.

At higher frequencies, the setting of both controls becomes much more critical and more skill is required to get the best results. You may find it easier to make tuning a two-handed job. In any case, it is comforting to know that, with correctly adjusted regeneration, the set performs as well as much larger sets do without regeneration.

BACKGROUND NOISE

Because the sensitivity increases with the regeneration, the background noise increases at the critical point, and you can use this fact to help you pick the best setting when looking for a weak station.

If you are looking for a weak station and are not perfectly sure where to find it, you can set the reaction control so that the detector is just weakly oscillating. The signal generated by the oscillator will combine with the signal from the aerial to give an audible whistle or beat.

This feature of regenerative receivers is handy if you wish to listen to unmodulated morse signals on the shortwave bands.

Don't allow the detector to oscillate strongly, especially on the broadcast band, because it generates a signal which may be strong enough to cause interference with nearby receivers.

The winding of the coils is not too difficult a job, but it does require a certain amount of care. The material from which the coil formers are made is a plastic called polystyrene.

It has excellent insulating properties and, under ordinary circumstances, good mechanical properties. However, it does soften appreciably under the heat of a soldering iron. Since the wires must be soldered to the pins in the base of the former in order to make connection, care must be taken not to distort them.

If you are not too happy about your ability to solder quickly, you could make up a jig from an old six-pin valve socket to hold the pins in place while soldering.

It is usually easiest to start with the primary winding, then the secondary and finally the reaction. If you can check the space occupied by the required number of turns and drill the holes in the former before starting the winding you will save time.

The grid winding of the 570Kc to 2Mc coil occupies 1¼ inches and the grid winding of the 1.2Mc to 4.7Mc coil about 7-8 inches.

PIN CONNECTIONS

We have suggested a set of pin connections, but if for some reason you would rather wire them another way, there is no reason why not. Coil formers with different numbers of pins could be used, but you must have at least five pins to make the required number of connections.

Some liberties are permissible with the gauge of wire, and, although different gauges will vary the coverage, this may not be serious. You may find it easier to get wire in B and S rather than SWG gauges, in which case 36 B and S enamel may be substituted for the 40 SWG, 30 B and S for the 32 SWG and 24 B and S for the 25 SWG.

We have tried to keep the number of different wire gauges down to a minimum, but it is difficult to do the job with fewer than three.

The 40 SWG wire used for the reaction winding of the broadcast coil is necessary in order to fit the required number of turns into the available space. It requires care in handling so we have used larger wire for the reaction windings of the other coils.

Some fine emery cloth can be used to remove the enamel from the wire before soldering. Rub two pieces together to dull the cutting edges so that excessive copper will not be removed.

DIFFERENT AERIALS

Because the regenerative circuit is so intimately connected with the aerial, it is reasonable to expect that some adjustment of the coils will be necessary to suit different aerials. We generally visualise an aerial about 40 feet long suspended about 30 feet above the ground and a lead-in coming fairly directly down to the set.

In some cases, there will be room for a larger aerial even than this but, at the same time, there are flat dwellers who will have to be happy with a piece of wire strung around the picture-rail.

Incidentally, an earth is always necessary with a battery-powered receiver of this type. If you can solder a wire to a tin and bury it in the earth, a connection to a nearby water pipe will serve as well.

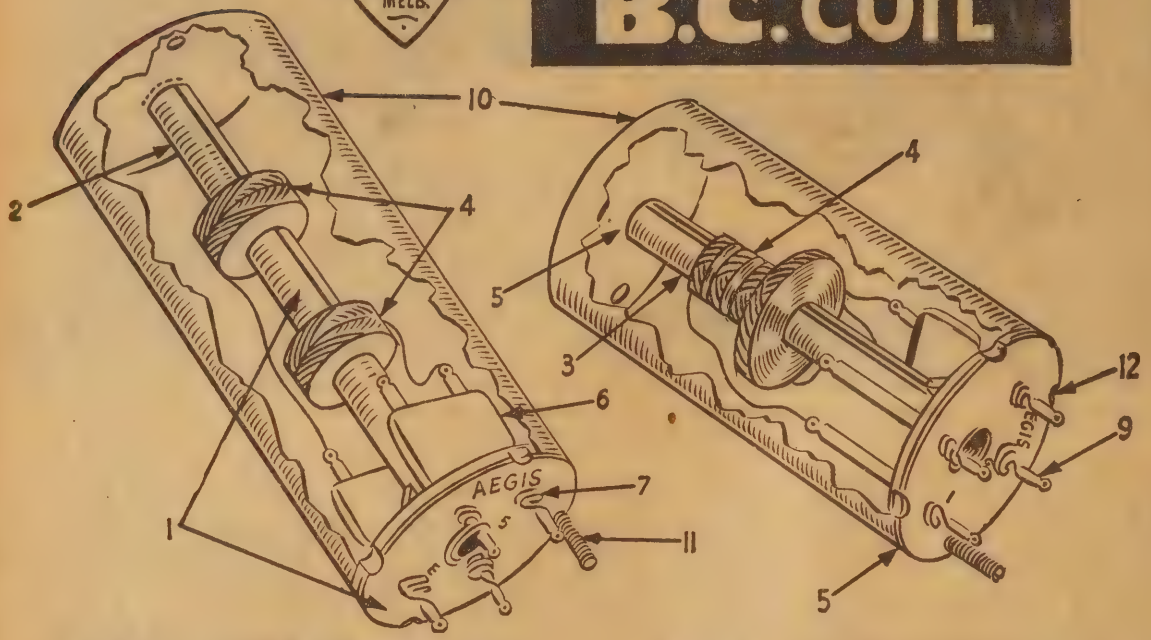
For very long aerials you may find that the set is not sufficiently selective and difficulty is experienced in getting it to oscillate with the coil data given. In this case, best results may be achieved by reducing the

SECTIONAL VIEWS OF THE NEW . . .

RADIO PARTS
AEGIS
CEN. 3688
MELB.

I.F. TRANSFORMER

B.C. COIL



1. ONE-piece, moulded high-quality clear polystyrene former and base.
2. Former has moulded internal threads.
3. High quality 6 m.m. externally threaded adjustable iron-dust cores.
4. High-Q Litz wire windings having minimum diameter to reduce damping by shield-can.
5. Former supported at each end to eliminate vibration within shield can.
6. Quality silvered-mica capacitors moulded in mica-filled phenolic resin for stability and low losses. One piece built-in terminal lugs of silver-plated copper (no spot welding). Capacitors kept to within plus or minus 2½ pc when possible, on I.F. Transformers only.
7. Full 3/16in of solid polystyrene around base terminals.
8. Units flash-dipped in best quality high melting point wax.
9. Base terminals shaped to simplify connections.
10. Soft-drawn pure aluminium shield can.
11. Sturdy plated brass eyebolts with special self-starting threads.
12. Shield-can permanently clamped to coil or I.F.T. base to eliminate accidental damage to windings by can slipping off after purchase is made.
I.F.'s measure 3in x 1 3-8in diam.
COILS: 2¼in x 1 3-8in diam.

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M9 Coils B/C. Aerial.
M11 Coils B/C. Osc. 6AN7, 6J8G.
M10 Coils B/C. R.F. 6BE6, 6AE8.
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number of turns on the aerial winding.

On the other hand, if a short aerial is used, greater volume may be obtained by increasing slightly the number of turns on the aerial winding.

Similarly, slight adjustment of the reaction winding may be required to get optimum results. If the set refuses to oscillate over portion of the range it may be necessary to add a few turns to the reaction winding. If you have too many turns the set will oscillate easily over the whole band, but the control will be excessively critical.

An exception is the coil for the highest frequency range. With the IT4 valve the upper frequency limit for efficient operation is somewhere about 15Mc, so we have made this the high frequency end of the top band.

BY NEXT COIL

When the reaction winding is adjusted for smooth operation at the high frequency end it may not oscillate at the low frequency end. However, this is not important, because the range is covered by the next coil in the list.

The figures we have given for the top coil are frequencies over which it does actually perform satisfactorily.

If you wind up the coils exactly as suggested by the coil table, the chances are 10 to 1 that the set will work perfectly at the first trial and the above suggestions are made only to aid those who are anxious to get the very best out of the receiver.

From any location in Australia you will be able to receive dozens of stations of the broadcast band and most of the powerful overseas shortwave transmitters will be audible at one time or another. It won't outperform a costly communication receiver, but you get very much better value for your money than a man who pays out hundreds of pounds for such a set.

Don't be discouraged if you cannot put up an elaborate aerial. You won't do as well as the chap with the big aerial, but surprising results can be had with a few feet of wire.

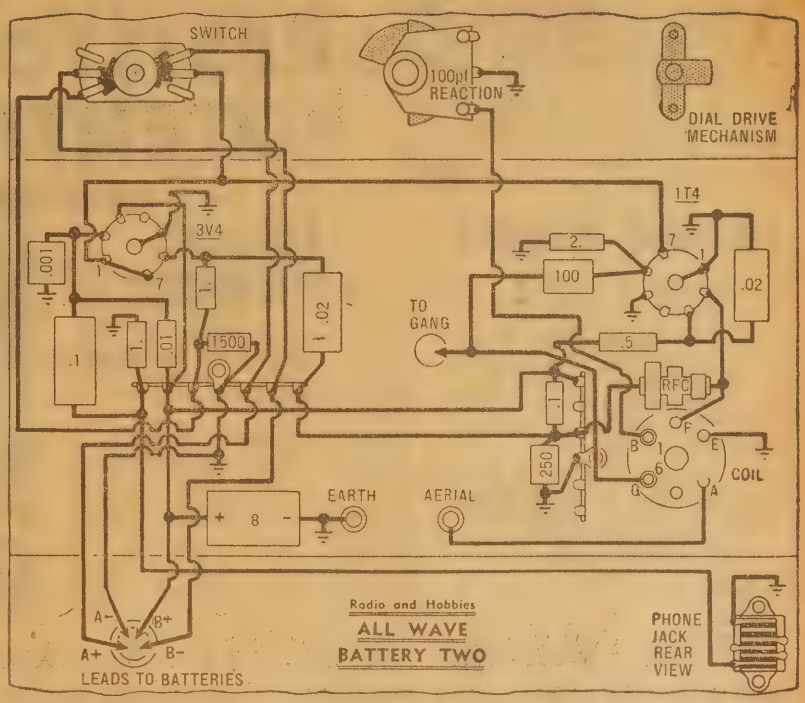
The new set was built on a chassis originally designed for the 1953 "Little Jim" described in the May issue last year. You will be able to order a chassis with all the holes already stamped from your radio parts supplier. A few of the holes will not be used, but this is not important.

The photographs and wiring diagram show where to place all the parts. The wiring diagram is not perfectly realistic because it sometimes shows solder joints in mid-air, whereas actually they are made at valve sockets and tie points. It is quite permissible to use some initiative here, because, with the exception of one lead, the wiring is not at all critical.

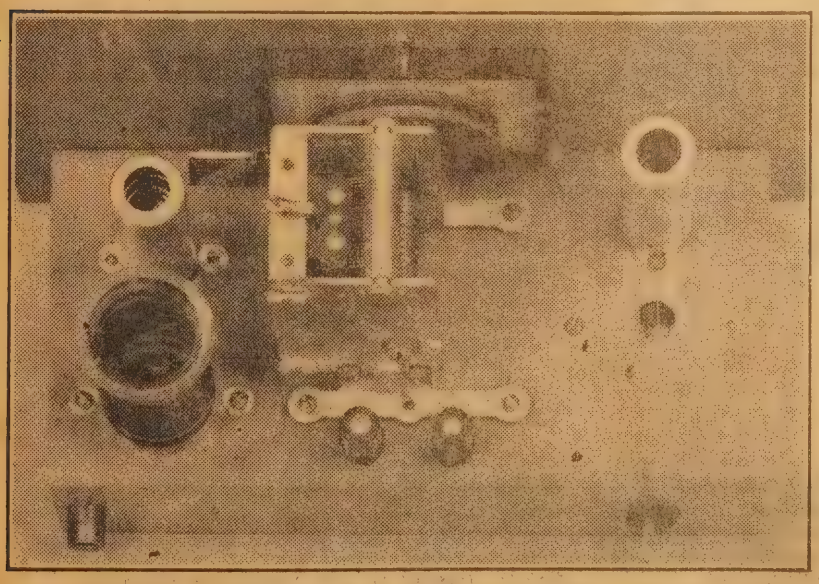
The point to watch is that the lead from the plate of the 3V4 to the phone jack should not go too close to the grid wiring of the 1T4. In the normal way there will be no danger of any trouble, but it is as well to be sure. Had we been designing a new chassis we would have put the phone jack on the other side. You can do this if you make up your own.

We have used shielded sockets for both valves, but they are not necessary from an electrical point of view. The mechanical protection, however, is well worthwhile.

WIRING DETAILS OF NEW SET



This diagram is to help people who have not had much experience in wiring receivers from schematic circuits of the type published on page 71. The earth symbol indicates that the wire must be returned to the chassis or a bare busbar running around the chassis. It need not necessarily be at the exact spot shown.



The IT4 detector is behind the coil to the left and the 3V4 to the right. Aerial and earth terminals are in the centre behind the tuning capacitor.

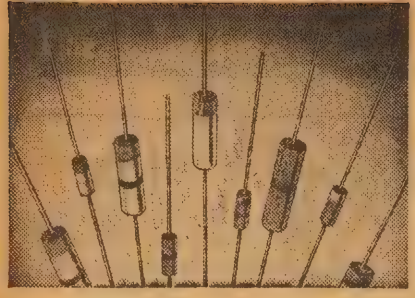
USING A SPEAKER

Readers living near strong stations may like to try a speaker instead of headphones. For best results, it would be necessary to increase the high tension to 90 volts and reduce the back bias resistor to a value less than 1500 ohms. We suggest 1000 ohms.

Although this will not give the maximum audio power output of which the 3V4 is capable, there will be plenty for most purposes and the batteries will last for a long time.

The speaker must be a permanent magnet type, preferably one of fairly modern design and fitted with a transformer reflecting a load of 10,000 ohms. The primary winding of the transformer should simply be connected in place of the 10,000 ohm resistor at present shown in the circuit.

The coupling capacitor, phone jack and 1.0 meg resistor will not be required unless you wish to connect the phones as an alternative. In the



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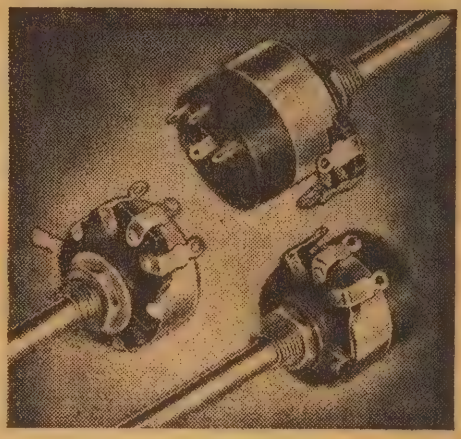

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1332-3H	200-220-230-240	300	120	2 x 6.3v-2A; 5v-3A	53/3
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1371-8	200-220-230-240	500-600-750 850-1000	300		150/-
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	MAX	FULL RATE DC				
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967-1A	35	20	150	200	1000	46/-
956-1A	30	20	200	160	1000	57/9
1011-1A	30	15	250	160	1000	59/6
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986-1A	15	10	300	60	1000	62/6

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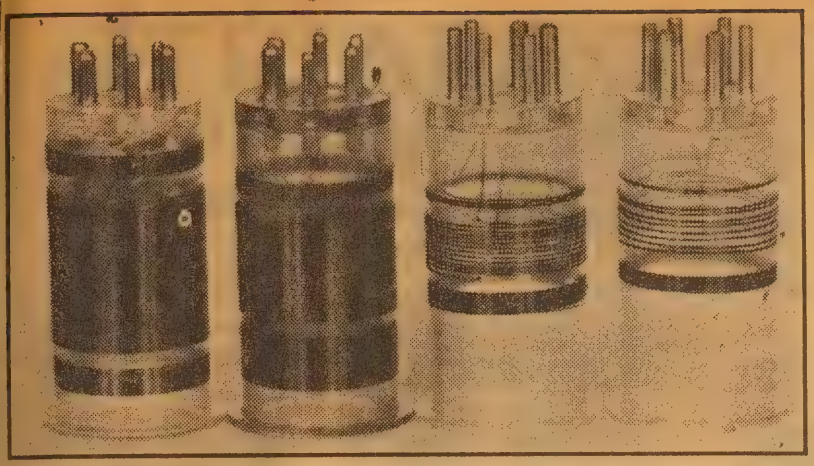


Four coils are needed to cover the complete range between 570 Kc and 16 Mc.

latter case, you could wire the speaker transformer in permanently in place of the resistor and render the speaker inoperative by breaking the voice coil circuit.

Battery valves have fragile filaments in order to keep the current drain down and, should the high tension battery be accidentally connected across the filament circuit, both valves will be ruined on the instant.

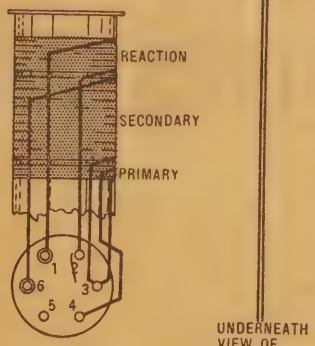
To make sure that this does not happen, check the wiring very carefully before plugging in the valves and connecting the batteries. Label the battery leads so there will be no mistake.

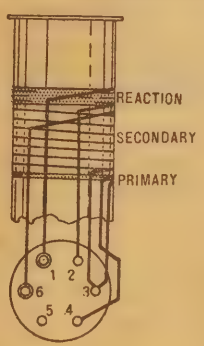
Connect the 1.5 volt battery first, and switch on. With the valve shields off you should be able to look down the tops of the valves and observe the filaments glowing a dull red color. They don't give out very much light, so that you may need to take the set away from strong light.

Having made sure the filament circuit is okay, you can connect the 45-volt battery and, in all probability, you will be able to start tuning in stations right from the word go.

The dial calibrations are dependent to some extent on the number of turns of the reaction and aerial windings of the coils as well as the length of aerial you use. Having adjusted the coils for best performance and decided on the aerial it is a good idea to make a note of the dial reading for various stations so that you will know where to find them again. The list of broadcast stations which was published on page 112 of the February issue should help.

Mr. Cushen's list of short-wave stations, which is published in each issue, will also prove interesting. Information is given about the frequencies, strengths and times of operation of many stations. Don't be put off by the fact that the set has only two valves. You will probably log quite a respectable list at the first sitting.





UNDERNEATH VIEW OF COIL PINS

	570 Kc to 2Mc (Broadcast Band)	1.2Mc to 4.7Mc	3.0Mc to 11.0Mc	8Mc to 16Mc
PRIMARY	15T. 32 SWG Enam. Spaced 3/16in from earthed end of secondary	11T. 32 SWG Enam. Spaced 1/8in from earthed end of secondary	5T. 32 SWG Enam. Spaced 1/16in from earthed end of secondary	2T. 32 SWG Enam. Spaced 1/16in from earthed end of secondary
SECONDARY	100T. 32 SWG Enam. Close wound.	38T. 25 SWG Enam. Close wound	13T. 25 SWG Enam. Spaced to occupy ½in.	8T. 25 SWG Enam. Spaced to occupy ½in.
REACTION (may require adjustment)	60T. 40 SWG Enam. Spaced 1/8in from grid end of secondary	35T. 32 SWG Enam. Spaced 1/8in from grid end of secondary	16T. 32 SWG Enam. Spaced 1/8in from grid end of secondary	10T. 32 SWG Enam. Spaced 1/8in from grid end of secondary

Coils wound to the above specifications worked well in our laboratory model but minor modifications may be necessary to suit individual aerials. Note that a standard commercial broadcast coil can be fitted with a 6-pin plug and used instead of the coil shown here.

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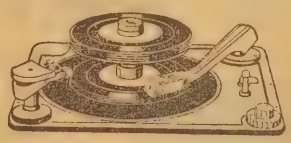
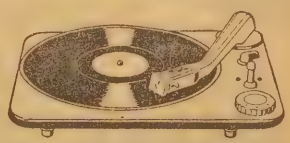


DUAL Changer Model 1002/F complete with NORMAL and LARGE CENTRESPINDLES.
PRICE (Sydney) **£35/12/6**



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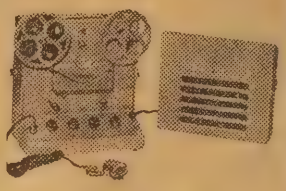

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B.A.S.F.		7in. Plastic,	10/6
1200ft. ...	£3/12/6	5in. Plastic,	9/6
600ft. ...	£2/5/-	7in. Metal .	10/6
AGFA		5in. Metal..	8/6
1200ft. ..	£3/12/6		
600ft. ...	£2/5/-		

Flywheels, 2-speed, balanced & ground..	£3	19	6
Pinch wheels . .		10	6
Reel holders, ¼ or 3-16in shaft. Each		12	6
Osc. Coils and Circuit		18	6
Bearings, Oilite		1	0
HEADS—			
ELMEC, twin track, dual gap	£4	17	6
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HERE'S YOUR ANSWER, TOM!

(Continued from Page 55)

save writing a whole string of zero symbols, the micromicrofarad was introduced.

This is 1-millionth of a microfarad or 1-millionmillionth of a farad. A 1 micromicrofarad capacitor is very small, but we can think of applications in high frequency radio work where such a value is important.

The word, micromicrofarad, is rather long, and it is often more convenient to use picrofarad, which means the same thing. Picrofarad can be abbreviated as simply "pf". Similarly, microfarad can be abbreviated as "mfd".

CORRECT SYMBOL

Although "mfd" is usually accepted in radio circles, there is a possibility of confusion with millifarad, a unit which is rarely used. The correct symbol for the prefix "micro", is the Greek letter "mu". Unfortunately, there are few typewriters or printing machines able to reproduce the letter mu.

It is something like the letter "u", but with a long tail on the left-hand side. Thus, the strictly correct symbol for microfarad is "uF", for micromicrofarad "uuF", and for picrofarad "pF", if you can imagine the long tail on the "mu" in each case.

Different abbreviations are accepted as standard with different publications throughout the world, Tom, so that it is a good idea to be familiar with as many as possible.

You will note that we have adopted "pf" as standard for picrofarad and "mfd" for microfarad.

Could you please tell me where the word "potentiometer", comes from? It does not appear to have anything to do with volume controls.

We'll be glad to do our best, Tom!

A potentiometer strictly is a precision instrument for measuring the value of an electric potential. It can be used in conjunction with a standard cell and a galvanometer to provide very accurate voltage readings.

VARIABLE TAP

Essentially, it consists of a fixed resistor with a variable calibrated tap. The calibrations are in terms of voltage and are made with a particular current flowing through the resistance element of the potentiometer.

Thus, with a given total resistance and current flowing a particular voltage will appear across the whole of the potentiometer. Any desired fraction of this voltage can be tapped off between the moving arm and one end of the element.

If, now, one terminal of a standard cell is connected to one end of the resistance element and the other to the variable tap via a galvanometer, the position of the tap can be adjusted so that the galvanometer reads zero. When this is the case the voltage appearing across the end of the resistance element is the same as the standard cell.

Any other potential source can now be measured by substituting it for the standard cell and moving the tap until the galvanometer again reads zero. The voltage of the source will be proportional to the resistance between the tap and the end of the resistance element.

CALIBRATION METHOD

In practice, the potentiometer is usually calibrated beforehand. The procedure in setting it up is then to set the dial to read the voltage of the standard cell and vary the current passing through the element by means of an external rheostat. When the calibration point is established, all the other readings automatically correspond with the dial.

An ordinary radio volume control could actually be used as a potentiometer if it were calibrated. The order of accuracy would not be very great because the device is not designed with this use in mind.

When used as a volume control the general potentiometer idea is still present. A portion of the alternating audio potential appearing across the full resistance of the element is tapped off and passed on to the audio amplifier.

WILL RADIO, LIGHT WAVES MEET?

(Continued from Page 69)

waves might be put when practically achieved. To question the ultimate utility of this portion of the spectrum is probably just as fallacious as it was in 1920 to think that all wavelengths below 200 metres are worthless.

If history again repeats, this portion of the radio frequency spectrum should become as important to the art of communication as any which preceded it.

It is true that waves of this length are difficult to generate, transmission lines to handle them are critical and high absorption occurs in the atmosphere to make even line-of-sight transmission marginal. However, once the first two of these shortcomings are overcome, the last may even become an advantage.

The limitation to very short ranges in the free atmosphere might make highly personalised forms of radio communication possible. Also, because of the small size of the waveguides associated with millimetre waves, long-distance communications through evacuated or gas-filled waveguides, consisting virtually of "hollow wires", would become possible.

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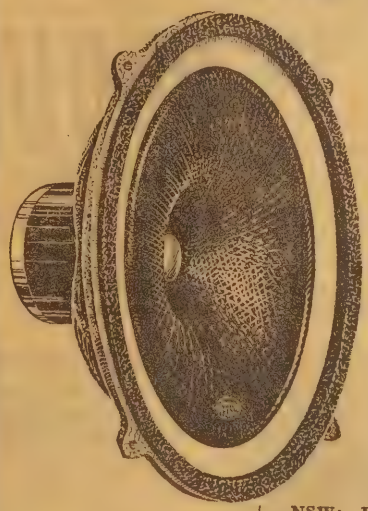

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Testing the Performance of your Amplifier

Provided one can purchase or borrow a frequency test record, it is entirely possible for the home amplifier enthusiast to assess the frequency response of his equipment with nothing more to help him than an AC/DC multimeter. This article tells you how to go about it.

IN a laboratory, tests of this nature involve a good deal of time and equipment, because the figures have to provide a complete analysis of the equipment, not just the end result.

In our own case, amplifiers, preamplifiers and compensation systems are tested separately, using an audio generator, valve voltmeter and an oscilloscope. The results are plotted for separate examination and later verified by taking an overall run from pickup input to speaker output.

Pickups are tested quite separately. Their output is fed through a level preamplifier system, thence to a valve voltmeter calibrated in decibels and a parallel oscilloscope. This latter allows observation of the waveform and ensures that no overload occurs in the measuring circuits.

PROPER LOAD

Care is taken to see that the pickup under test is coupled into the specified load system and, when plotting the final result, due attention is paid to the level of each frequency track on the test recording. This latter information is always marked on the label.

By adding or subtracting these amounts from the output reading, one can then plot a curve which shows the frequency law of the pickup itself. One can deduce from it, in turn, the amount of correction needed in the amplifier circuits.

If it happens to be a crystal pickup, intended to provide its own bass boost, one can assess whether this is sufficient or not to offset the attenuation in the bass end of the recording.

TOO COMPLEX

While this represents the more or less standard laboratory approach, it involves too much complexity and equipment for the non-professional amplifier enthusiast.

It might be very instructive to know how each item in his equipment is functioning but his chief concern is with overall performance.

What is the approximate frequency response of the system when I play my favorite recordings with my own gear and all controls in their usual settings?

Standard test recordings can provide the answer to this question. Though not carried in stock by all and sundry, they can usually be obtained on order from record dealers.

Depending on where your interests lay, you can buy a 78 rpm test record, 33 rpm microgroove test record, or both .(It can be assumed, for the time being, that the performance of a microgroove head will be much the same for 33 or 45 rpm discs.)

Typical discs are the HMV 78 rpm disc ED1189, covering in small steps the range between 50 and 20,000 cps. Then there is the Decca 33 rpm microgroove LXT2695, covering frequencies between 40 and 15,000 cps.

Fortunately, these and most other test recordings are cut with the same general frequency law as ordinary recordings in their class.

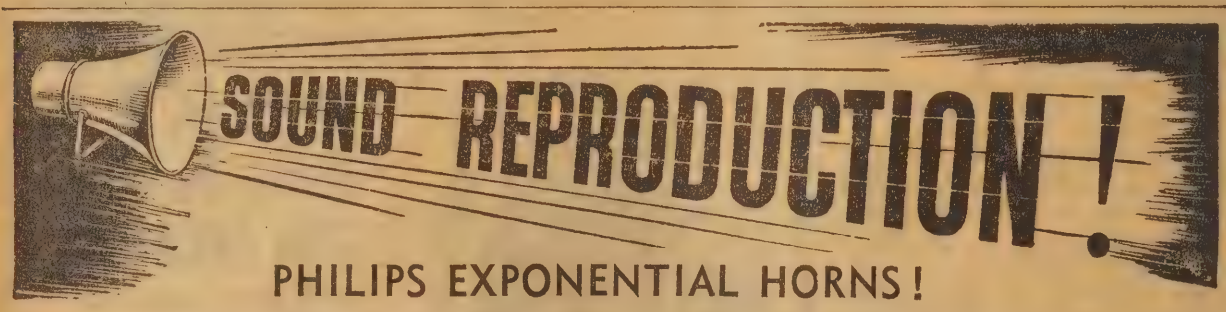
Thus the ED1189 disc is level above 1000 cps but has a bass roll-off starting just above 250 cps and amounting to minus 14 db at 50 cps.

If this record is played through a system set up for ordinary 78 rpm discs, the voltage fed to the speaker should remain substantially constant at all frequencies.

TYPICAL MICROGROOVE

Similarly, the LXT2695 disc incorporates a degree of bass attenuation and treble pre-emphasis typical of microgroove discs and should likewise produce a substantially level output when played through an amplifier system set up for microgrooves.

To be sure, individual brands of discs do vary in the amount of attenuation and pre-emphasis they employ and due allowance can be made for this variation where the information is available. However, a run through with a standard test re-



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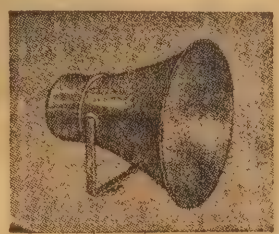

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ording will serve to show peaks and oughs in the overall response from ylus to speaker input; it will also low any obvious inadequacy in the mount of bass or treble correction.

In some cases it may mean nothing ore than a simple re-setting of a ne control knob. It may mean a hange in the value of a tone correc- on condenser or, in the case of an ncompensated crystal pickup, a var- ation in load value.

Of course, the final result, as heard n the room, will be modified by the peaker characteristics and that is nfortunately something that the en- husiast cannot measure. However, lmost irrespective of speaker per- ormance, it is most helpful to be ble to identify and correct for short- omings in the amplifier and pickup ystem.

NOT CONCLUSIVE

Merely listening to the output while playing through a test recording may indicate peaks and troughs in the response but it is rather inconclusive because the ears are very unreliable as a measuring device. Furthermore, there is no way of differentiating between pickup and amplifier characteristics and those of the speaker and listening room.

It is far better to measure the output from the amplifier, as delivered to the speaker. This can be done with an ordinary AC/DC multimeter, most of these instruments having negligible frequency error over the audible range.

The main problem is how to connect the meter to the amplifier.

While we are measuring output it is generally unwise to use the "OUTPUT" position of the multimeter, because the in-built blocking condenser is likely to be too small to handle the bass end properly. It is better to make direct use of the AC ranges.

(It is not a bad idea also to choose an evening for the tests when the rest of the family are at the pictures.)

If your speaker system has a 15-ohm voice coil, it is only necessary to clip the multimeter across the voice coil leads and set it to the 10-volt AC range. Then, without turning up the gain for more than a watt or so of output, quite a reasonable reading can be obtained on the meter.

If your meter has a decibel scale, the simplest course is to set the amplifier volume so that the reading is exactly "0db" with the pickup playing the 1000 cps track. Then, as the pickup is made to play other tracks, you can read off directly the rise and fall in output with frequency.

A FAIR EFFORT

If the reading does not vary over the range say 50 to 10,000 cps by more than plus or minus 3db, you can feel reasonably pleased with the result. Only a well-adjusted system will do much better than that.

Variations greater than about plus or minus 3db will begin to have a noticeable effect on the performance.

If you find that the pointer is edging up around the 6 or 7 volt mark in any portion of the range, remember that this is approaching 10 watts and therefore the overload region of most amplifiers.

You can establish the ratio of this peak to the 1000 cps reference by resetting the control so that the meter reads say minus 5db on 1000 cps. It may then swing up to say plus 2db on the peak, indicating that the peak or rise is 7db above reference.

Similarly, if the response at the bass end tends to drop so low as to be scarcely readable, you can begin by setting the response at 1000 cps to say plus 5db and then reading the bass levels in relation to this. Thus a reading of minus 2db at 50 cps would mean that the response at this frequency is 7db down on your 1000-cycle reference and it can be so marked on the graph.

If the speaker voice coil has an impedance of less than 15 ohms, it is most unlikely that the amplifier will be able to develop sufficient voltage across it to ensure a worthwhile reading on the multimeter.

One simple way to overcome this difficulty is to connect the voice coil winding of another output transformer across the speaker voice coil, and couple the multimeter to the secondary leads. You should then be able to find a range on the meter and a volume control setting that will enable a suitable reading to be had on the meter.

Use the best transformer you can find, however, to avoid metering errors.

As an alternative to this, the AC leads can be clipped between the plates of a push-pull amplifier or between plate and B-plus of a single output stage. A 2 to 4 mfd condenser in series with one lead will overcome any difficulty of an initial reading due to DC drop across the winding.

RATIO THAT MATTERS

The range on which you take the readings is immaterial provided it is always below the overload region of the equipment. The purpose of the test is to establish the ratio of the response at all frequencies to that at the accepted reference of 1000 cps.

If your meter has no decibel scale, it will be necessary to do a little arithmetic. We suggest you adjust the controls to give you half-scale voltage reading on 1000 cps.

On some parts of the range the readings will be above 5 by a certain ratio, in which the response will be so many db "up".

On other parts of the range, the reading will be less than 5, giving you a new ratio of 5 divided by the new reading. Here the amplifier will be so many db "down".

Thus 10 volts will be 6db up and 2½ volts will be 6db down.

Just to help you work things out, here are a few approximate decibel figures converted from voltage ratios: 1db is 1.22; 2db is 1.26; 3db is 1.41; 4db is 1.6; 5db is 1.8; 6db is 2; 7db is 2.24; 8db is 2.51; 9db is 2.82; 10db is 3.16.

You will find it quite accurate enough to work out the voltage ratios and plot the response curve to the nearest decibel.

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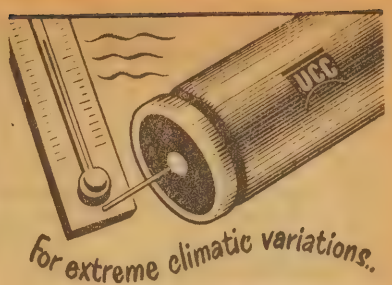

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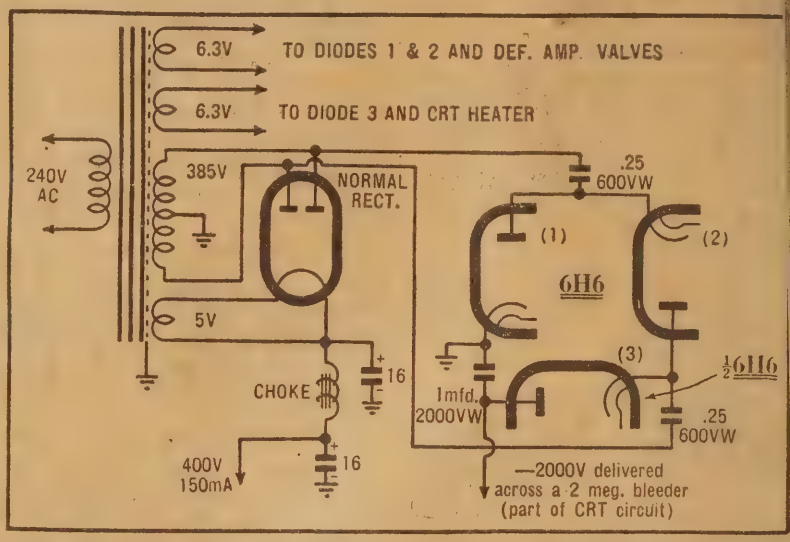
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

STANDARD POWER TRANSFORMER GIVES HV FOR CRT

Provision of extra high tension (EHT) for a cathode ray tube would normally call for a special power transformer, the use of an RF power supply, or the application of voltage multiplying circuits to a low-voltage transformer. Here is a circuit illustrating the third method and using a standard power transformer.



THE circuit was submitted by Mr. J. W. Waugh, of 33 Glebe St., Edgecliff, Sydney, NSW.

Our contributor does not claim originality for it, and mentions that he modified another published circuit which used metal rectifiers. As a matter of fact, similar circuits appeared in an article on page 37 of the June, 1950, issue of Radio and Hobbies. We felt, however, that these details would be of interest to new readers of the past couple of years.

The power transformer used was one rated at 385 volts a side. It should be of the 80 mA size or greater in order to be of the type which provides two 6.3 volt and one 5-volt windings. This current rating is much in excess of that necessary to supply the time base valve and the deflection amplifiers, but this does not matter.

The transformer should ideally be modified to improve the insulation of one of the 6.3 volt windings. Normally, one of these windings will be on the outside, but it would be wise to check this. Simply take out the core laminations and remove the winding, wrap on another couple of layers of suitable insulation and replace the winding, taking care that the outside turns do not tend to slip off. This winding may then be used to feed the heater of the CRT and the lower diode section in the circuit diagram.

As you can see from the circuit diagram the transformer feeds two separate rectifier and filter networks one employing a conventional 5-volt full-wave rectifier and inductance capacitance filter for the time base and deflection amplifiers, the other using three diode elements in a voltage-multiplying circuit. Duo-diode 6H6 valves are used here because of their relatively easy procurement at a fairly low price.

The voltage ratings of these valves are greatly exceeded, but lengthy tests by various individuals have indicated the practicability of the scheme.

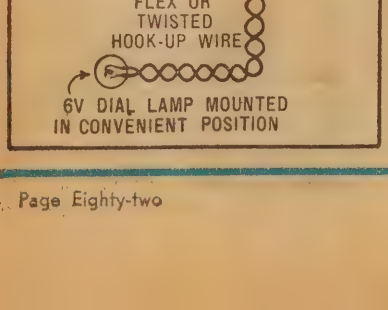
According to our contributor, a 350 volts a side transformer will provide about 1850 volts in this circuit. For a given transformer, the value of the capacitors will have a bearing on the output voltage. Thus if a lower voltage is desired, the value of the .25 mfd 600-volt capacitor can be reduced.

Note the voltage rating of the capacitors. These should be considered as minimum ratings. Tubular capacitors are available for the 600-volt rating, and possibly for the 1500-volt rating. However, for this latter figure and the 2000-volt rating, there is a reasonable chance of obtaining suitable capacitors through war equipment disposals sources.

The output voltage is also sensitive to the current drain. The EHT bleed circuit of the CRT should be of the order of 1.5 to 2 megohms so that the total current drain is very little over about 1 mA.

INDICATOR LAMP CHECKS IRON

Here is a simple scheme submitted by Mr. N. V. Moller, of 5 Stone St., Brighton East, S6, Victoria, for keeping a rough check on the switch contact resistance of a low voltage soldering iron.


SOLDERING IRON TRANSFORMER
TO LOW-VOLTAGE IRON
CONNECTIONS TO POWER MAINS
FLEX OR TWISTED HOOK-UP WIRE
6V DIAL LAMP MOUNTED IN CONVENIENT POSITION

With this type of iron the carbon tip and the back of the copper bit become dirty after a certain amount of use and, to retain the quick-heating feature, it is necessary to remove the copper bit and clean it.

The scheme involves wiring a 6.3 volt dial lamp through a length of twisted hook-up or flex across the low voltage secondary winding of the transformer, and mounting the lamp in a position where it can readily be seen while using the iron.

If the carbon-copper contact is clean, the lamp will dim appreciably when the ring-switch of the iron is operated. The amount of dimming decreases as the inside end of the copper bit becomes dirty, and it thus serves as an indication of the efficiency of the contact.

IS THE EXTRA H.P. DANGEROUS?

(Continued from Page 11)

erely a "dividend" resulting from gher horsepower.

"But why," ask some people, "can- ot fast acceleration be obtained by gher axle ratios and smaller en- nes, with lower top speeds?" It in, say the engineers, but as a crifice of economy. Fast accelera- on with economy requires engines f high compression and high per- rmance.

High horsepower in itself is no uarantee of best performance or ighest speed. Each car-maker owers his engine to suit the over- ll design of his car. Some makers ress economy, others performance.

Even lower-priced cars in Amer- a have performance which en- bles them to keep pace with more xpensive makes, and thus maintain fairly uniform highway traffic- peed pattern. As a result, Ameri- an cars are sufficiently powered o pass each other promptly and et out of each other's way.

In England, where many low-pow- red vehicles are mixed on the high- vay with high-powered cars, passing azards are greater, and England's raffic fatality rate is about double hat of the US.

DEATH RATE HIGH

In the 1930's, when some alarm- sts became concerned about the horsepower race", the fatality rate vas about 15 deaths per 100-mil- ion vehicle miles. Today, it is 7.3 —total annual motor-vehicle deaths n the US are about where they vere in 1936 (38,000); meanwhile, notor-vehicle registrations have nearly doubled.

Nevertheless, higher horsepowers lo mean higher top speeds. What part do these slightly increased top peeds play in highway deaths? No one can say for certain, but all obtainable facts indicate that "high peed" is not the mass murderer it s usually touted to be.

Last year, an analysis was made f all accidents reported by the State police on the Pennsylvania Turnpike in the previous 11½ years. Less than one pc of the vehicles nvolved in accidents were travel- ing at 71 mph or faster. Seventy- ive pc of the accident-involved pas- enger cars were moving at speeds f less than 51 miles per hour.

The US Bureau of Public Roads eports that, contrary to popular be- ief, the average highway driving peed is still about 50 mph. Says he National Safety Council: "We ave never been able to prove that ccident frequency increases with peed."

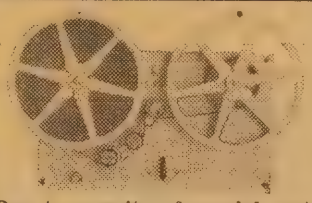
High speed, of course, increases the accident severity. As for the relationship of high horsepower to all accidents, records for rural speed violations indicate that cars of all ages, makes and horsepower are involved in about the normal vehicle-registration ratio. The inescapable conclusion is that the driver is the decisive factor in auto accidents and highway deaths. The human element—driver error—was the cause of 85 pc of all accidents on the Pennsylvania Turnpike.

P.A. FOR PLANES

GREAT BRITAIN'S new turbine airliners are to be fitted with loud-speaker public-address sys- em of passing written messages back o the passengers.

This will replace the usual sys- em of passing written messages back rom passenger to passenger, giving hem information about the flight.

In the past the noise from piston ngines has made it difficult to pro- uce a public-address system which ould be heard clearly all over he aircraft, which was also suffi- iently light in weight.



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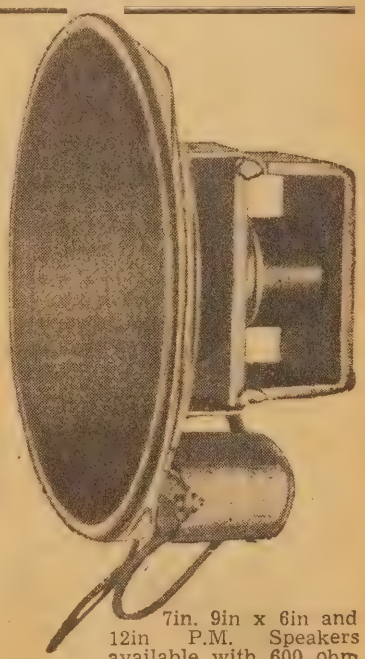

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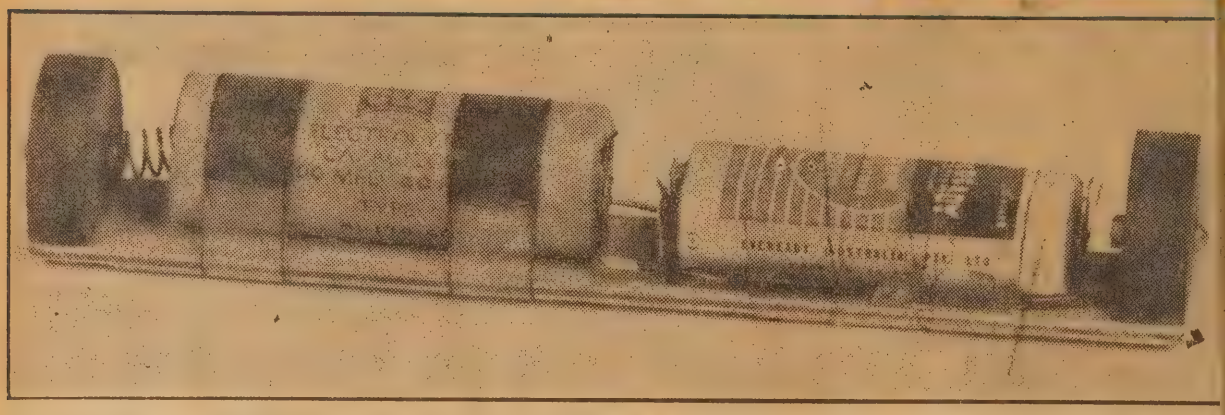
FURTHER HINTS ON FLASH BULBS



A typical home-made battery-capacitor unit of the type discussed in the text. Its size and shape are such that it directly replaces the three cells which most guns are designed to accommodate.

In the January issue, we discussed some characteristics of expendable flash bulbs together with hints on their manner of use. In this article we continue the discussion, covering such matters as reliability and testing, battery-capacitor units, multiple firing, and color correction.

THE fact that we are publishing these articles at the same time as we are experimenting with new electronic flash circuits may at first sight appear a little strange but in reality it is not so.

While it is true that electronic flash has replaced the expendable bulb in many applications, the two forms of lighting should be regarded as complementary rather than competitive.

As we pointed out in the previous article, there are many cases where the expendable bulb is superior to the electronic flash, whether it be due to the lower first cost, the very much greater light output, or the lighter and more compact equipment. The complete photographer needs to be conversant with them both.

One of the most important characteristics of any type of flash equipment is reliability.

ANTI-CLIMAX

Nothing is more exasperating than to spend a lot of time and trouble getting all the elements of a picture into exactly the right place and mood, building up the atmosphere in anticipation of the actual taking of the picture, only to create a woeful anti-climax when the bulb fails to fire. The deflation is hardly less than that of a scientist who has produced a "fizzer" instead of an atom-bomb.

For the Press photographer it can easily mean a picture lost for ever, and many have been the curses heaped upon a faulty flash bulb or associated equipment. On the other hand many a celebrity has endeared himself or herself to Pressmen by being sufficiently understanding to pose for a second shot without obvious irritation. Nevertheless, too many failures can sorely try the patience of both parties.

The fact that bulbs do fail must be faced and we might well consider the causes and possible precautions. Failures can be grouped into two broad classifications—those of the bulbs themselves and those of the associated equipment.

It seems almost certain that the greater proportion of failures is due to equipment, much of which is used by people who have little knowledge of how it works or how it should be cared for. Considering some of the abuse handed out to their equipment by many commercial and Press photographers, it is a wonder it works at all.

by Philip Watson

On the other hand it would be foolish to claim that all failures are due to equipment and that all flash bulbs are 100 pc perfect, because there is plenty of evidence that bulbs do fail on odd occasions. However, careful handling and correct testing can virtually eliminate these.

Two of the most frequent causes of bulb failure are undetected bulb fractures or slow leaks, which cause loss of oxygen, and open circuiting of the igniting filament. To cope with a loss of oxygen failure some manufacturers include a small spot of chemical on the inside of the bulb which remains blue in the presence of oxygen but will turn pink if this has leaked away. In this way a faulty bulb can be recognised and returned to the maker.

The other fault, an open circuit filament, may at first appear difficult to check, due to the possibility of firing the bulb if current is passed through it to check the continuity. However, this can be done quite safely providing the current flow is kept below a certain figure as recommended by the makers.

In practice it is usually quite safe to test bulbs by connecting them in series with a 1.5 volt cell and a 2.5 volt torch lamp, the torch lamp lighting if the filament is continuous. It also appears that the low ohms range of a typical ohmmeter (which passes 100 mA.) is quite safe. With modern bulbs filament failure is rare.

SLOW FIRING

The only other fault which appears to occur with some bulbs is a protracted ignition time so that, although the bulb fires, it does so much later than it should. It is seldom possible to detect this failure when it occurs because the time difference is too small for the eye to appreciate. However the effect is only too evident on the negative which is usually completely blank.

This is particularly so when a synchroniser has been used in conjunction with a high shutter speed. It is not so likely to cause trouble when used with the simple open flash technique.

There appears to be little that the user can do to protect himself from failures of this kind, although it has been claimed that they are less than when the bulb is fired with the higher voltage made available by the battery-capacitor system. We will have more to say about this in a moment. There seems little doubt that improved manufacturing techniques are rapidly overcoming this problem.

In the matter of equipment failure, the most frequent source of trouble is the battery. By this statement it should not be inferred that the bat-

teries are at fault, but, rather, that the user generally fails to realise the heavy current drain imposed on them every time a flash is fired. Even though the drain is only of brief duration, it is quite possible for the internal resistance of the cell to cause a pronounced drop in voltage. As a result, insufficient current flows through the lamp to fire it.

The cold resistance of a typical flash bulb is in the order of .75 ohm, which means that a 4.5 volt battery will be called upon to deliver 6 amps.

HEAVY DRAIN

In practice, it is unlikely to do so, due to its own internal resistance, but the voltage chosen provides a fair margin to ensure that the bulb will fire with fresh batteries. However, batteries which have had a lot of use or are stale can quite easily fail under such arduous conditions, even though they appear quite satisfactory under normal tests.

For this reason they should be tested under load conditions more nearly approximating the real thing.

The battery manufacturers point out that the cell usually used for this work was never designed for such loads, being essentially a torch cell designed to give the best possible life when operated at about 300 mA drain. To meet the special requirements of photographers some makers have marketed special types, having the same physical dimensions, but designed for heavier discharge rates. However, it seems most probable that this is only obtained at the expense of some other characteristic, such as capacity or shelf life.

BATTERY-CAPACITOR

To overcome this problem there has recently been developed an arrangement known as battery-capacitor firing, and this has many advantages. Although there are several variations of the scheme, the basic idea is to charge a high value electrolytic capacitor from a 22.5 or 30 volt hearing aid battery and to discharge the capacitor through the flash bulb to fire it.

The effect of such a scheme is to draw from the battery just sufficient energy to ensure reliable firing and to store it in the capacitor until it is required. In this way the battery is protected from heavy discharges which are undesirable, while the much lower internal resistance of the capacitor means that the stored energy can flow at a very much faster rate. In practice such a system is capable of delivering an initial current of 8 amps, far more than necessary to ensure reliable firing.

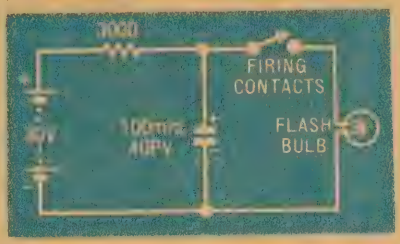
ECONOMY

The system is also very economical and one battery manufacturer states that a single battery should provide something like 20,000 flashes. In practice the limit is the shelf life of the battery, but there are plenty of instances where professional and Press photographers, firing many bulbs a day, have used a single battery for more than 12 months.

Two popular arrangements are shown in the accompanying circuits. In one the capacitor is simply connected permanently across the battery through a limiting resistor, this serving to isolate the battery from the heavy discharge during firing. A possible objection to this circuit is that there is a continuous drain on the battery due to the leakage of the electrolytic.

Practical experience indicates that this may limit the first battery life to about three months, but that better life, up to 12 months, is possible with subsequent batteries. This appears to be due to the improved characteristics of the electrolytic brought about by the prolonged application of voltage.

The other circuit overcomes this problem in a rather ingenious way.

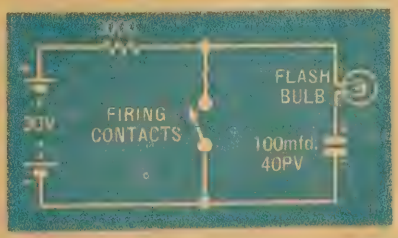


One circuit for a battery-capacitor system. The capacitor is connected permanently across the battery and causes a small continuous drain. However, it is still capable of good results.

In it the battery is disconnected from the capacitor until a bulb is placed in the socket, the charging circuit then being completed through the lamp and limiting resistor. The flow of current is too small to fire the bulb, but will charge the capacitor in about two seconds if the value of the limiting resistor is correctly chosen.

Closing the firing switch then connects the capacitor directly across the bulb and the latter fires. At the same time, there is a small drain on the battery due to the limiting resistor being connected directly across it. However, this is small and of very brief duration. In most cases the limiting resistor value should be about 3000 ohms, but this value can be varied to suit particular requirements.

The capacitor can be a 100 mfd 40-volt unit, such as the UCC type 51-130-40 or similar in other brands. This unit is of such a size that there



An alternative circuit in which the capacitor is charged only when the globe is placed in the socket. The charging time is only a few seconds and the battery is protected from unnecessary drain.

is no difficulty in accommodating it, together with a 30-volt hearing-aid battery, in the space normally occupied by three dry cells in a normal gun.

The usual arrangement is to mount this combination on a suitable frame which may be slipped into the gun in the same way as the cells, contacts at either end corresponding to those of the conventional battery terminals.

While on the subject of firing reliability, it may be as well to consider the problems of multiple flash, that is, the firing of several bulbs simultaneously, either to obtain more light or, more usually, to improve the lighting. It must be admitted that this is getting more on to a professional basis, since the cost of bulbs usually prevents the average amateur from firing them more than one at a time.

However, there may be odd occasions when such an arrangement is desirable and it is as well to appreciate the problems involved. It is fairly obvious that all the problems of battery internal resistance already mentioned will be multiplied in direct proportion to the number of lamps involved. For this reason only fresh batteries should be used when more than one bulb is to be fired or, better still, the battery capacitor system should be employed.

When using the battery-capacitor system for multiple flash it is usual to connect the bulbs in series to take advantage of the higher voltage. It is generally considered safe to connect up to four bulbs in series with this system.

FOCAL-PLANE SHUTTERS

Another problem which arises when flash bulbs are considered is their use with focal plane shutters. The original flash bulbs and most of those in use today are unsuitable for use with such cameras except when very low shutter speeds are used.

To fully appreciate this problem it is necessary to briefly discuss the characteristics of the focal plane shutter. These devices operate directly in front of the film (hence the term focal plane) and consist of two flexible opaque blinds which move across the front of the film when the shutter is fired. The mechanism is so arranged that there is a small gap between the end of one blind and the beginning of the next and it is this gap which provides the exposure.

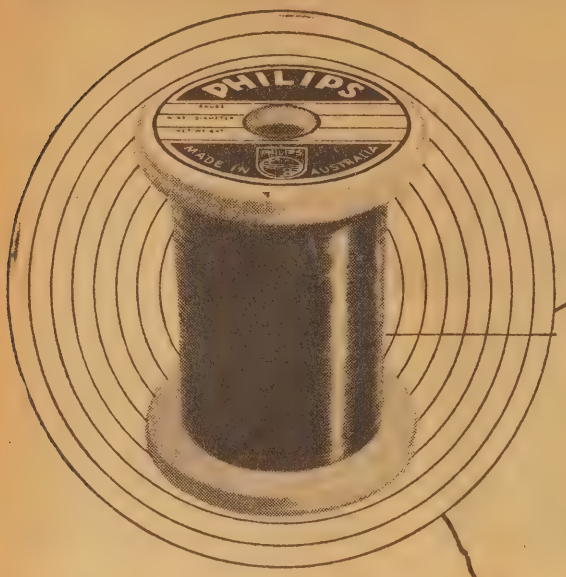
By varying the width of the gap as well as the speed at which the blinds travel across the film it is possible to vary the effective exposure of the film.

The main difference between this shutter and the between-the-lens type is that whereas the latter exposes the whole of the film area simultaneously the former exposes it a portion at a time. For this reason the period of exposure of any portion of the film will be very much less than the total time taken for the gap to pass across the entire face of the film.

ILLUMINATION PERIOD

Thus the focal plane shutter is capable of very high effective shutter speeds while retaining moderate speeds in the moving parts involved.

This is where the system presents a problem to the flash bulb user because, although the shutter may be operating at, say, 1/200 second the actual time the slit takes to move across the face of the film will be much longer than this and the scene



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	36	.0076	x	x	x	x
33		.0071	x	x	x	x
	37	.0068	x	x	x	x
34		.0063	x	x	x	x
	38	.0060	x	x	x	x
35		.0056	x	x	x	x
	39	.0052	x	x	x	x
36		.00500	x	x	x	x
	40	.0048	x	x	x	x
37		.00445	x	x	x	x
	41	.0044	x	x	x	x
	42	.0040	x	x	x	x
38		.00397	x	x	x	x
	43	.0036	x		x	x
39		.00353	x		x	x
	44	.0032	x		x	x
40		.00314	x		x	x
41	45	.00280	x		x	x
42		.00249	x		x	x
	46	.0024	x		x	x
43		.00222	x		x	x
	47	.0020	x		x	x
44		.00198	x		x	x
45		.00176	x		x	x

THE world-wide reputation that Philips have achieved for high quality fine wire is more than adequately maintained with the fine wire now being produced at Philips Hendon Factory.

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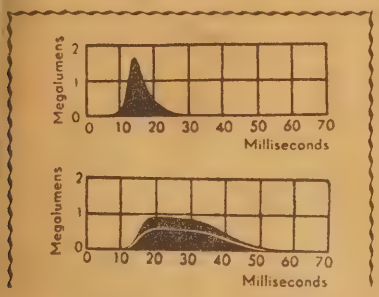
PG9-53

ill have to be evenly illuminated or this period.

Due to the sharp peak of light produced by the normal flash bulb the egative would be exposed over only small part of its area and then ith varying density.

For the slower shutter speeds, sually 1/25 second and longer, the lit is equal to the full width of the ilm and flash exposures at these peeds are quite satisfactory. Where ction shots are involved or the general illumination is bright enough to ause a secondary image other solutions to the problem must be found.

One of these was the development of special cameras, such as the Speed Graphic, which were equipped with both between-the-lens and focal plane shutters. Thus they were suitable for either daylight or flash bulb working, either type of shutter being selected as required. Cameras of this type proved very popular wiht Press photographers but, quite naturally, their cost puts them out of reach for most amateurs.



These two graphs show the difference in behavior between the standard type bulb and the focal plane variety. The top graph shows the short duration peak which is suitable for between-the-lens shutters and the lower one flat top characteristics suitable for focal plane shutters.

The other solution to the problem came from the lamp manufacturers themselves, who developed a bulb specially for use with focal plane shutters. This is a slower burning bulb than the normal types and has an essentially "flat top" characteristic. The use of these types makes possible high speed flash shots with focal plane shutters. As with between-the-lens shutters, some form of synchroniser must be used to delay the operation of the shutter mechanism until the bulb fires.

Typical bulbs of this type are the PF24 and PF45 in the Philips range and the S0 and S1 in the Wotan range.

COLOR

Another important characteristic of flash bulbs is the color of the light they emit. The color of the normal lamps tends toward the red end of the spectrum in much the same way as ordinary filament lamps, though to a lesser degree. For this reason they are not suitable for use with color film designed for daylight, producing an image which is far too red.

To overcome this, special types are coated with a blue lacquer designed to filter out the unwanted red rays and produce a light similar to daylight. These are very popular with professional photographers, since they may be used as a supplementary light in combination with daylight, or with daylight type film for studio working. Most types which are available in clear glass are also available with blue coatings.

When flash bulbs are to be used with color film designed for artificial light a further modification becomes necessary. This is because the clear glass types have not quite the same color as photographic filament lamps, for which artificial light film is designed, being slightly too blue. For this type of work, therefore, a light yellow lacquer coating is used, this filtering out the slight excess of blue light.

ATTENTION

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JOHN HIBBERT PTY. LTD., 481 KENT ST., SYDNEY—PHONE BX3446—HAVE NOW FULL DISTRIBUTION OF "Q PLUS" PRODUCTS IN N.S.W. WHOLESALERS CAN NOW BUY THEIR STOCKS IN SYDNEY INSTEAD OF FROM MELBOURNE—Q PLUS ARE TRYING TO

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Type TO-284 in models N, P, OV, T and TS with individual replaceable sapphire stylus assemblies for standard and microgroove records answers the demand for a quality cartridge. May be fitted to any American or European tone arm having standard ½" mounting centres. Price, £2. 12. 0.

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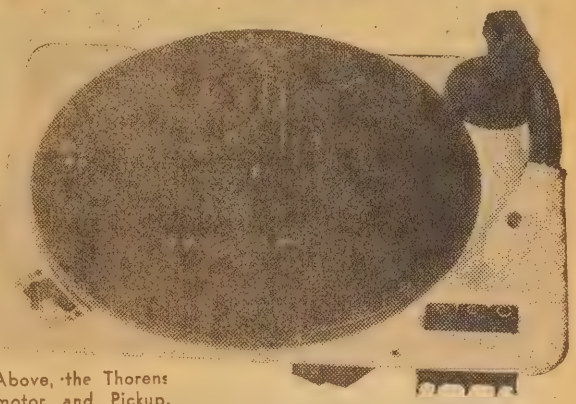
TRADE REVIEWS AND RELEASES

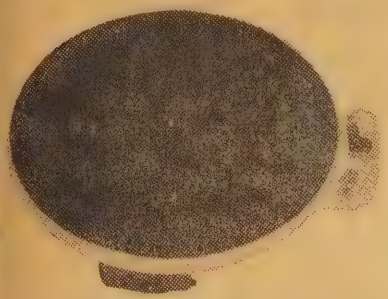
THORENS PLAYER HAS VARIABLE RELUCTANCE PICKUP

A particularly fine performance under test is a feature of the new Thorens phonopraph motor and pick-up sent to us for review by Audio Engineers of Kent St., Sydney. The unit is good enough to do justice to the best radiograms and speakers of the day.



Above, the Thorens motor and Pickup. Below, the motor alone.

THE motor is Swiss made, and the arm is fitted with an American GE variable reluctance pickup of a type famous overseas. Three speeds are available—78, 45, and 33 rpm—selected by a lever which also allows a small correction in speed if required. Speed reduction is by gears and governor, and precision workmanship ensures smooth rotation with no sign of rumble or "wow". Special spring mounting further assists in silent running.



Placement on and removal of the pickup from the record is automatic, and controlled by three press buttons on the motor board, one each for 7, 10, and 12 inch records. At the end of each record, the pick-up is returned to the start position and the motor stopped.

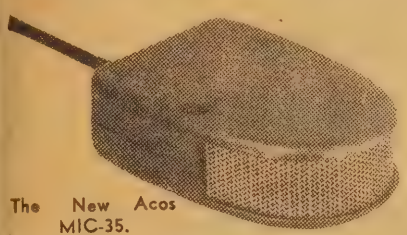
The pickup plays both 78 and microgrooves, the correct stylus being selected by rotating a knob on the head, which is also removable as a unit. The stylii are mounted independently of each other.

Pickup performance is extremely good. On microgroove, frequency response varies only two or three db up to 13 Kc and extends usefully to about 15 Kc. The observed waveform was perfect throughout—better than any comparable pickup tested to date. Pressure is a little high at 8 grams, but within recommended values. Record reproduction is superb indicating good stylus fit and tracking.

Pickup output is low at 10 millivolts and pre-amplification will be needed in many cases. Hum reaction between motor and pickup, however, is negligible. The motor is also available separately. The prices quoted are not low, but it is doubtful whether there is a better all-round player unit available here at present.

A NEW ACOS MICROPHONE & PICKUP

A new, inexpensive hand microphone and high compliance cartridges for the famous GP20 crystal pickup are noteworthy additions to the Acos lines, for which Amplion (Australasia) Pty. Ltd are the agents.



The New Acos MIC-35.

THE microphone is Acos MIC-35—a general purpose type for hand or desk mounting, robust in construction and handy in size. Substantially flat response is claimed from 50-5000 cycles and the level is usefully high at -55 db.

It has a built-in resistor of 2 megs, which makes it suitable for direct connection to the grid circuit of an input valve.

It is most attractively priced at £2/15/-, complete with 4ft of co-axial cable.

Tested on speech it gave very good results when fed into a typical amplifier, very little inferior to those from more expensive types. It should find many general purpose applications.

New, high complicance replacement cartridges for the GP20 pick-up will be welcomed by phonograph enthusiasts. These are similar in appearance to the old heads, but have not only a much higher compliance, but greatly improved frequency response.

Tests indicate that the characteristic peak at about 6 Kc has been virtually removed, and top response moved up to approximately 13 Kc. A broad rise of moderate amplitude occurs centring at about 4 Kc, which could be reduced by simple filter to provide virtually flat response.

Played directly into a .5 meg load, both heads were appreciably smoother than the original types and should give even less record wear and much better tracking. They are the best Acos cartridges we have tested to date.

New Acos heads type HGP39 and HGP39LP.

ROLA RELEASE 12UX LOUDSPEAKER

Rola's new 12UX wide-range loudspeaker is the best performer this firm has released to date and compares favorably with imported speakers in or around its price class.

IT is based on the well-known 12U design, and has similar power ratings. It is, however, fitted with a subsiduary inner cone, which extends the high frequency range to about 12 Kc.

The main cone has a treated surround to reduce its resonance, which is round the 50 cycle mark, and to provide smoother response in the lower range.

In this regard it could be considered as a big brother to the previously released 12-OX.

Its performance, however, is much superior, and it impresses as a particularly "safe" speaker for better class, higher-powered equipment. Its larger magnet structure provides better transient response and the efficiency is quite high.

Oscillator tests failed to reveal any objectionable peaks or holes in the response, which is commendably smooth through the full range. It appears to have a moderate rise in the middle register giving a little extra body to its quality, and adequately baffled, gives even response down to about 40 cycles.

A New Superb ACOS CRYSTAL PICK-UP

IT'S TOPS!
IT'S NEW!
IT'S HERE!

The HGP 39 cartridges will also fit the GP 20 arm.

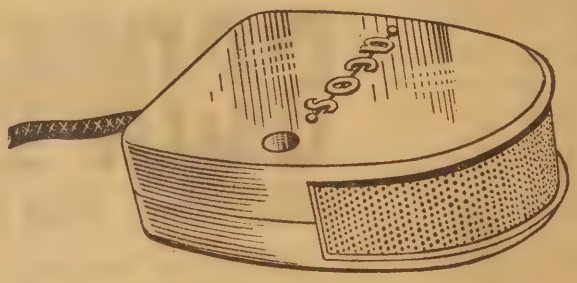
The outstanding features of this pick-up are:—

- High compliance, low element mass.
- Completely hermetically sealed crystal unit.
- High output.
- Low stylus pressure, with the minimum of record wear.
- Interchangeable pick-up heads with replaceable sapphire styli.

SPECIFICATION

Response	flat from 40 cps to 13 Kcs.
Overall response	20cps to 17 Kcs.
Output	1 volt on standard records, 1/3 volt on microgroove records
Tracking Weight	8 grammes

Australian Agents: AMPLION (A'sia) PTY. LTD., Sydney, N.S.W.



A NEW SENSATIONAL CRYSTAL MICROPHONE!

ACOS MIC 35 (HAND AND/OR DESK TYPE)

AT THE AMAZING PRICE OF

£2/15/0

A general purpose microphone with high sensitivity and substantially flat characteristic. Housed in attractive Die Cast Case of very robust construction is particularly suitable for use in recording apparatus — Public Address Equipment — Dance Bands — and similar applications.

Provided with built-in shunt resistance of 2 megohm giving response substantially flat from 50/5,000 cps. Resistance of the input circuit will reduce the low frequency response. A grid leak of ½ megohm will reduce the output at 500 cps by 3 dbs and pro rata at lower frequencies.

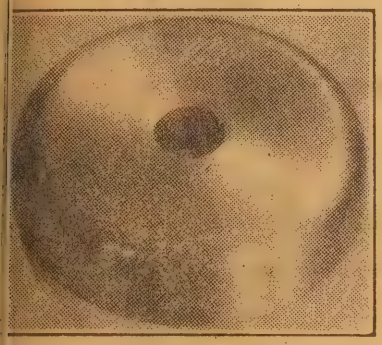
Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

Frequency response	Substantially flat from 50/5,000 cps.
Output level	= 55 db ref. 1 volt/dyne/cm2.
Load resistance	2 megohms included.
Cable	This microphone is supplied with approximately 4ft. (1.2 metres of co-axial cable (type Unirad 32).
Weight	Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes).
Dimensions	Microphone only 2 7/8in x 2 1/8in x 7/8in plus cable. Complete with packing 3 3/8in x 2⅜in x 2¼in.

Australian Agents: AMPLION (A'sia) PTY. LTD. Sydney, N.S.W.

ADAPTOR FOR 45 RPM RECORDS

A handy device for record enthusiasts is the adaptor illustrated below, recently put on the market by Hodges Sound Systems.



TURNED from aluminium, the adaptor slips over the turn-table spindle and provides a neat fit for the large centre hole in 45 rpm records. It has a neat satin-chrome finish.

The adaptor is being released through radio trade houses and retail music stores. The manufacturer's address is Hodges Sound Systems, Lewis St., Balgowlah, NSW.

FERGUSON TRANSFORMERS

MESSRS. FERGUSON TRANSFORMERS PTY. LTD advise that they have redesigned several of their vibrator transformers, obtaining a further increase in efficiency and low radiation properties.

The transformers involved are types VT127, VT132, VT107, VT117. New type numbers are respectively VT204, VT207, VT208, and VT209. They have 6-volt or 12-volt primaries and output ratings of 200V. 50mA, and 250V, 60mA.

Overall dimensions are given as height 3 1-8, breadth 2 5-8, width 2 inches, with open vertical mounting brackets.

EDDYSTONE RECEIVERS

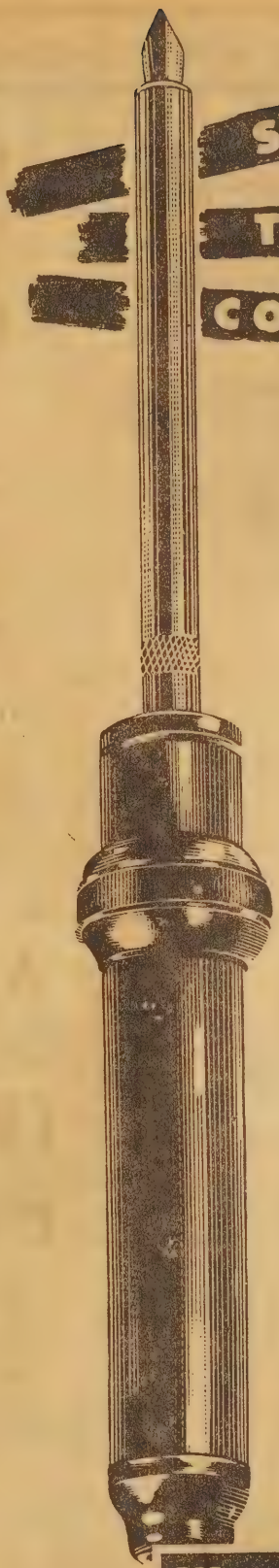
FROM Messrs. R. H. Cunningham Pty. Ltd. comes news of a new high quality Eddystone Communications receiver, designated as model 700.

The receiver has extremely wide coverage—15Kc to 31Mc, and has been designed to meet exacting specifications laid down by the Allied Governments and the British Post Office.

The sensitivity is quoted at 2 to 5 microvolts above 100 Kc and 5 to 10 microvolts below 100 Kc. Some of its main features are automatic gain control, noise limiting, listening-through facility, tuning indication and panel metering of all valves.

Construction is of alloy diecasting for the front panel and coil box, and heavy gauge steel or brass for the remainder. Metal parts are rust-protected and the receiver is suitable for tropical use. The unpacked weight is 134lb.

Further details available from Messrs. R. H. Cunningham Pty. Ltd., 118 Wattletree Rd., Armadale, SE3, Victoria.



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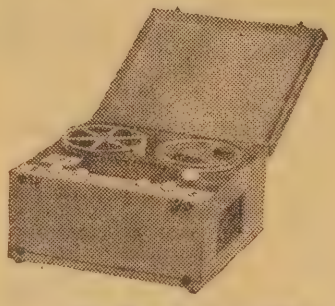

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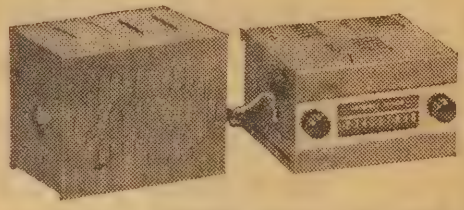

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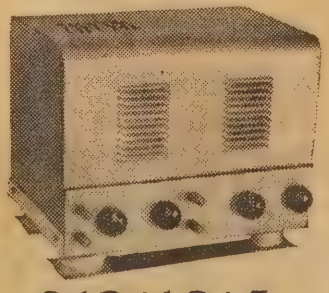

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OFF THE RECORD — NEWS & REVIEWS

Once again, let me stress the importance of discarding your playing stylus when it shows signs of wear. Too many people, often with good equipment, fail miserably to estimate the number of sides played since their last replacement, and blame their records for bad reproduction.

By JOHN MOYLE

TWO cases came under my notice only this month of exactly this experience. One concerned a virtual newcomer to semi-permanent styli, who was just about to give up in despair. His stylus simply had no point left, and he was fortunate that we tracked it down before he did much damage to a fine collection.

The other man was just plain forgetful. He couldn't believe his ears when a new point was fitted, and started in all over again on records he had given away as hopeless.

CERTAINLY WEARS

The almost standard sapphire stylus is NOT permanent or anything like it. It is an inexpensive method of obtaining a well-polished point which will last a reasonable time without replacement. It was the obvious successor to the steel point which, even 10 years ago, had long outlived its ability to stand up to even one full-blooded side.

It is almost impossible to say how many sides a point will play. High quality, very lightweight pick-ups impose much less stress on the point than the more robust, dual-point types, for instance, and might improve on the latter's results by several times. The only sure sign is a deterioration in quality of a known good record, commencing with the inner grooves and gradually increasing with time.

The reason for this is that stylus wear increases the point diameter, as well as malforming it, so that it can no longer sit the grooves and follow them. Because the lateral displacement of the grooves is more crowded near the centre (where the circumference is obviously much less than at the outside) the effect of this enlarged point shows up more seriously.

It's a very good thing to keep a spare stylus at hand and to try it out if you have any doubts. This doesn't apply to a stylus which can be reinserted in a new position, as once removed it must go back the same way as it came out. But most pick-ups today use an armature assembly which can fit the head in only one fashion.

APPROXIMATE LIMIT

If I had to make a guess, I would say that about 100 12-inch sides would represent a fair limit for good reproduction. But I doubt whether any such figure could be quoted with any degree of confidence, because the rate of wear varies over wide limits.

Personally, I think it will be only a matter of time before diamond points or some equivalent come in more general use, but even these have their traps for the unwary.

CHOPIN—Polonaises Opus 26 Nos. 1 and 2, Opus 40 Nos. 1 and 2, Opus 44 and Opus 53, played by Artur Rubinstein. HMV ALP1028.

The hardest of all instruments t record well is almost certainly th piano.

In the first place it is percussiv in its nature—at the moment th hammer strikes the strings the soun is loudest, dying away very rapidly As a result, the peak output of an given note is many times highe than its average value over a few seconds of time.

The recording engineer has therefore to provide that this peak valu doesn't overload his equipment, a the same time ensuring that th average value of the sound i enough to keep the recording appropriately above the general noise level.

In other words, he must try to avoid distortion on loud passages or one hand, and puny remote reproduction on the other.

I have long suspected that much of recorded piano distortion is caused by overload in the microphone amplifiers which, being ahead of the gain controls, are beyond help. This effect seems most noticeable in broadcasts where microphone placement isn't under really good control.

WOW IS FATAL

Another difficulty in reproducing pianos is the need for absolutely constant motor speed. The smallest amount of "wow" will cause intolerable pitch changes and the inevitable "banjo" effect. All in all, good results from a piano record comprise a tribute both to the recordist and the reproducer.

This record of Rubinstein's takes several high marks technically. I doubt whether there is a single distorted or blasted note on either side, despite the considerable weight when called for. On a good machine, therefore, it sounds quite impressive. The microphone is a little closely placed for my liking, which may account for some right-hand swamping where it shouldn't be, and is responsible for some sense of oppression after the first 15 minutes. But it is a most creditable effort for all that, and in general it is clean and convincing. Frequency range is adequate but not wide. The bass end is good.

Rubinstein's performance, however, won't stand the highest criticism. It is sound enough, and bears the stamp of an old hand. But I thought it lacked imagination and fire. There is quite enough change in mood for these pieces to stand out with their own individuality; Rubenstein makes them sound too

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monotonously alike. Even the famous A major lacks the firm fire without which it is just another hackneyed exam. piece. I've heard them played very much less competently than this, but they aren't of the stamp which brings you from your seat.

My disc had a few crackles which may be due to wear, but I think the honors go to the recording engineer rather than the pianist. Good Chopin is rarely heard.

TCHAIKOWSKY — Symphony No. 4 in F Minor, played by the Vienna Philharmonic Orchestra conducted by Wilhelm Furtwangler. HMV ALP1025. Symphony No. 6 in B Minor (Pathetique) played by the Philharmonia Orchestra conducted by Guido Cantelli. HMV ALP1042.

The symphonies of Tchaikowsky are somewhat unique in music. One could in fact make out a case that they are not symphonies at all, but giant tone-poems. We must admit that they lean heavily that way, as against the more classical concept. There is little philosophical or intellectual background to any of them — they are essays in uninhibited emotions frankly and wildly expressed at times. Not that there is anything wrong with that, and at some period of our lives, generally the early part, we can take such music in large doses and be profoundly stirred by it.

These two symphonies are perhaps as good as any other examples of Tchaikowsky's methods and successes. They are also good examples of how he may be played.

WRONG APPROACH?

Furtwangler in the 4th sets out to invest the score with a significance I feel it does not possess. With the possible exception of the last movement, he plays the music analytically and introspectively, with a reserve and restraint which to me falls somewhat flat because I don't feel there is enough there for him to dig out. I can't convince myself that there is anything very mysterious or profound to justify deep research. His efforts tend to become somewhat pretentious—he postures when exhibition seems more appropriate.

Cantelli, on the other hand, makes no such attempts. He realises that the greatest musical impact is obtained by maintaining the pressure, achieving drive and movement, by avoiding any check to the flow of ideas and sound. His results are infinitely more cohesive, he leaves us with a much better sense of shape where Furtwangler's efforts tend to drag. To put it crudely, he doesn't mess about—he is bright where Furtwangler tends to become pompous, his vitality preserves the sharp edges where Furtwangler rounds them off.

His is a most satisfying and exciting performance. Only in the last movement of the 4th does Furtwangler approach the great climaxes which Cantelli achieves. Cantelli would never have been satisfied, even here, with the tame opening of the last movement of the 4th—so tame that I suspect the recording engineer was caught napping.

Apart from my personal reactions to both performances in a general way, orchestrally they are both good, although in neither case is the recording remarkable for wide range. But they are convincing for all that, and do not lack weight where it is called for. At the end of Furtwangler's long first movement there is some dulling of tone which might not be important on the average machine. The surfaces show some crackles, but both records as supplied to me had been played before.

If you are interested in Tchaikowsky, by all means hear both these records. He is one composer where considerable latitude in interpretation is permissible, and your tastes may not be parallel with mine.

BEETHOVEN NO. 3

Beethoven—Symphony No. 3 in E flat Opus 55 (Eroica), played by the Austrian Symphony Orchestra conducted by Fritz Busch. Festival CFR 12-91.

The Eroica was Beethoven's first "big" symphony, a colossal step forward in his symphonic progress. Apart from the Ninth, it shares with the Fifth most of the limelight, and rightly so, for it is a magnificent work. There is little hope for the man so blase that he cannot consider it as a permanent item of diet at regular intervals, to rediscover and to marvel. This is music which cannot be approached lightly either by performer or by listener, only the best will do.

I have played all the Eroicas I could lay my hands on during the last few weeks in an endeavor to assess this record, and conclude that it is possibly the best all-round version released so far. It isn't the best performance to my ears—I must give that palm easily to Toscanini who is a formidable opponent for even the best of the rest.

But this record is, I think, the smoothest of them all, and the cleanest to play. The surface, too, is extremely quiet, which is a good thing because it hasn't the weight of many recent orchestral discs, the orchestra being more remote.

I can't say that I thought this a bad thing, as frankly many of these "big" recordings can become quite oppressive unless you can get well away from the speaker. Even then, it's rarely possible to replace that spatial effect artificially.

STRAIGHTFORWARD

The performance is straightforward—pretty strictly to the book—but it isn't dull or flabby. Its attack and outline are quite firm and confident if somewhat inflexible at times. The microphone placement misses little if anything, all instruments are clean and well balanced. I have no doubt we will some day hear an Eroica which will overshadow this one, but in the meantime it seems to me a competent piece of work.

What a pity the second movement is broken by the turn-over.

Once again I must compliment Festival on the excellent annotations on the jacket.

Negro Spirituals—sung by Todd Duncan, accompanist Carroll Hollister. Festival CFR 12-156.

One of the most famous of spiritual singers is Todd Duncan, and no one could quarrel with either the performance or recording of these eighteen—nine per side. All the old favorites are here, in fact, just about every one of any note is included. There isn't much more to be said except that if you are spiritually-minded, all concerned have here served you well. The surface is particularly good, and both sides play cleanly to the end. Technically, one of the best Festivals.

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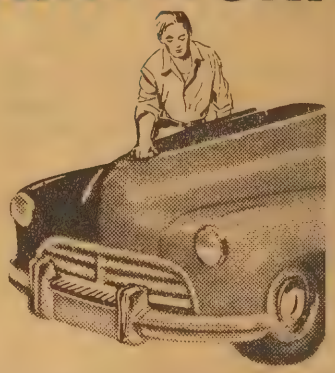

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Following the large English releases summarised last month, the only new records for February are from the major recording companies and there is nothing very substantial in their latest lists.

By DISCOBOLUS

MV have added ten LP's, including a first recording of the nfonia Antarctica by Vaughan illiams. This work was suggested by the film, Scott of the Antctic, for which Vaughan Wiams wrote the incidental music.

Their others include two Schubert mphonies by the London Mozart ayers, the Menuhin-Furtwangler eethoven Violin Concerto, two eethoven Sonatas by Solomon, and e now famous Toscanini Fountains nd Pines of Rome.

The ballet, Homage to the Queen, erformed on Coronation Night last une, is also making its first reorded appearance.

Traviata, as broadcast by the NBC December, 1946, and previously sued on 78's, is in the new lists, ut the recording was never very rilliant and gains nothing from its ansfer to LP.

EW VOLUMES

Columbia offer the Bach B Minor ass with Karajan and Elizabeth chwarzkopf, the Brahms 1st Symhony, excerpts from Tannhauser nd Tristan, the Berg Violin Conerto, Les Preludes and Caprice alian by Galliera, and a disc of ozart piano works by Gieseking, belled volume 1, which may mean ore to come.

Decca have announced a forthoming release of the Bartok Piano oncerto No. 3 by Julius Katchen, nd numerous conversions to edium-Play of earlier LP releases.

Their only new, but weighty, rease is on five LP's, devoted to exmples of Gregorian Chant, for hich they make available a brohure, giving an introduction to the ubject, together with the musical otation, the Latin text with Engsh translations, and commentars on each piece recorded.

NIXA have only half a dozen new sues, from Urania and Westminster. he opera, Lucia di Lammermoor, is out to appear in two versions, by olumbia and Urania.

Timed to coincide with the reease in London in March of the lm, The Glenn Miller Story, an LP as been issued containing ten numers recorded by the band between 939 and 1942. All the well-known 3's by the Miller band are includ.

NTIRE GROUPS

Vox are featuring Lili Kraus and e Vienna Symphony Orchestra in lozart piano works, and have some are Vivaldi pieces, together with wo Schubert sonatas.

Many of the American companes are now embarking on projects nvolving entire groups of works of arious composers, rather than reeasing discs in a piecemeal fashon.

Thus, American Decca have signd up Claudio Arrau to record the entire piano works of Chopin, and the Haydn Society are in the middle of a series which will make available all the Haydn quartets Twenty-nine have appeared to date.

In the field of play-back equipment, attention is being given to flexibility in the equaliser circuits, by the better manufacturers.

One firm specialising in high-quality amplifier gear now has as standard a preamplifier including a loudness control; a rumble filter, five push-button positions for bass turnover, the same for treble, and five positions of boost and cut about each one. All positions can be related to the curves of the various companies, and all are clearly labelled.

REVIEWING EQUIPMENT

Other companies have similar devices, and it is notable that all now show a tendency to omit the 78 positions, and provide instead a variety of LP positions.

While the American position in the matter of differing characteristics may be thought to be peculiar to them, it should be borne in mind that many of the American labels are appearing in England and Australia, retining the American characteristics.

Lack of appreciation of this point has given rise to adverse comment by reviewers, whose equipment is inflexible by 1954 standards. In fact, the well-known reviewer for the Gramophone, Mr. Desmond Shawe-Taylor, has opened the subject in the February issue, claiming that reviewers are surely in many instances arriving at an estimation of their own equipment, rather than of the records they are playing.

The time is probably not far distant when magazines will be asked to describe the equipment their reviewers are using, and it is in the interests of the record-buying public who look to them for guidance that they should do so.

Many of the large manufacturers in USA are voicing their protests at the sales promotion indulged in by makers of equipment in boxes no larger than a large table set, who call the result High Fidelity. Attempts are being made to define the term in accordance with a system of standards for pickups, amplifiers and speakers.

Ultimately, of course, results from even the best of equipment depend to a large extent on room acoustics, and whether the listener has a cold. It has been shown that this last cause can mean a roll-off in a treble amounting to 10db at 10,000 cycles on its own. However, this and kindred matters cannot be discussed in a few lines.

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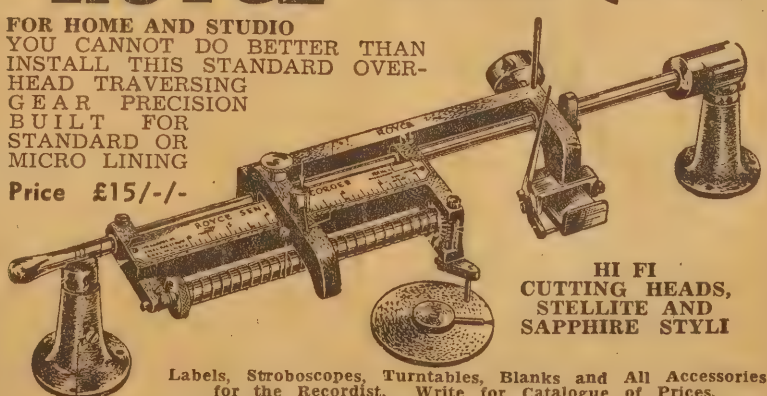

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SHORT-WAVE NOTES BY ART CUSHEN

RADIO FREE EUROPE EXTENDS

Radio Free Europe, with transmitters in Germany and Portugal, has been received at fair strength on many frequencies, on a greatly extended schedule.

RADIO Free Europe, which is a division of the National Committee for a Free Europe Inc., with headquarters at 110 West 5th St., New York, 19, has extended the schedules to listeners behind the Iron Curtain and now broadcasts in Czecho-slovak, Polish, Bulgarian, Rumanian and Hungarian.

35 FREQUENCIES

Free Europe operates on 35 frequencies at varying times during its transmission, which are very severely jammed. Most of the frequencies are split frequencies, which not only mean jamming on the RFE transmitter, but also side band inter-ference to other nearby signals. Radio Free Europe has transmitters located at Biblis and Holzkkirchen in Germany and Lisbon in Portugal. The transmitter use from 5000 to 50,000W except the medium-wave station, using 719 kilocycles, with 135,000W.

Studios are located at Munich, Germany, and the broadcasts are easily identified by the use of the Freedom Bell.

The schedule of Radio Free Europe is as follows:—

719Kc: Czech, 1.58 pm-9.5 am.
5970Kc: Czech, 1.58 pm-9.5 am.
5985Kc: Polish, 1.55-6.25 pm, 7.53 pm-12.20 am, 12.53-9.0 am.
6020Kc: Polish, 3.0-9.0 am.
6095Kc: Hungarian, 2.56 pm-9.0 am.
6105Kc: Czech, 1.58 pm-9.5 am.
6130Kc: Hungarian, 2.56 pm-2.30 am.
6130Kc: Bulgarian, 2.58-3.45, 4.25-5.15, 5.55-6.45 am.
6130Kc: Rumanian, 3.45-4-25, 5.15-5.55, 6.45-7.26 am.
7140Kc: Hungarian, 2.56-5.20 pm, 6.45-9.0 am.
7145Kc: Polish, 1.55-6.25, 7.53 pm-12.20 am, 12.53-9.0 am.
7155Kc: Czech, 1.58-6.45 pm, 6.0-9.5 am.
7175Kc: Polish, 3.0-9.0 am.
7180Kc: Czech, 1.58-5.0 pm, 7.0-9.5 am.
7192Kc: Hungarian, 2.56 pm-9.0 am.
7285Kc: Polish, 7.25-9.0 am.
7300Kc: Polish, 1.55-6.25 pm, 7.53 pm-12.20 am, 12.53-2.20 am.
7300Kc: Bulgarian, 2.58-3.45, 4.25-5.15, 5.55-6.45 am.
7300Kc: Rumanian, 3.45-4-25, 5.15-5.55, 6.45-7.26 am.
9655Kc: Polish, 1.55-6.25 pm, 5.50-9.0 am.
9695Kc: Czech, 1.58 pm-9.5 am.
9712Kc: Polish, 1.55-6.25 pm.
9717Kc: Polish, 1.55-6.25 pm, 7.53-12.20 am, 12.53-9.0 am.
9725Kc: Hungarian, 2.56 pm-9.0 am.
9750Kc: Hungarian, 2.56-6.50 pm, 7.0-9.0 am.
11,725Kc: Polish, 7.53 pm-12.20 am, 12.53-7.10 am.
11,745Kc: Czech, 5.0 pm-5.45 am.
11,755Kc: Czech, 4.45-6.45 am.
11,855Kc: Hungarian, 4.35-6.45 am.
11,885Kc: Hungarian, 5.40 pm-6.30 am.
15,145Kc: Polish, 7.53 pm-12.20 am, 12.53-5.35 am.
15,185Kc: Hungarian, 7.0 pm-4.20 am.
15,365Kc: Czech, 5.51 pm-4.35 am.

Our thanks to the Universalite for the schedule details, the first complete list we have been able to secure.

RADIO LIBERATION

A further Free Europe station, called Radio Liberation, operates with transmitters at Munich and uses 10,000W. The full studio address is Lilienthalstrasse 2, Munich 19. The transmitters operate from 8 pm to 8.30 am, with broadcasts in various Russian dialects. Frequencies of 6175Kc and 7130Kc are employed.

Both Radio Free Europe and Radio Liberation appreciate reception reports and listeners should give the station some comparison with the signals on other frequencies. The degree of the success or otherwise of the jamming of the programs will be of great interest to the technical staff. Radio Free Europe verify with a card, and letter, when reports are sent to the New York address.

NOTES FOR THE NEXT ISSUE

NOTES for the April issue close on March 6th, May issue on April 10th at 212, Earn Street, Invercargill, N.Z. All Times used are Eastern Australian Standard.

FROM THE MAILB

RADIO TASHKENT, Tashkent, Uzbe tan, in the heart of the Asian contin confirmed our reception of the Engl broadcasts heard on 6825Kc at 10.30 with a letter in English, together wi three postcard views of the city. Ve cation signer is Bakhram Abdullayev the Correspondence Department. Ta kent operates with 15,000W.

COPENHAGEN'S broadcasts to the East on OZF7 (15,165) have over rec weeks been received at good stren This broadcast from Denmark has ne been received at the strength we exp ence from Stockholm and Oslo stations the nearby frequencies, so it is pleas to hear the Voice of Denmark at s good strength. The transmission opens 7 pm on Tuesday, Thursday and Saturd with identification signal followed by chimes of the Town Hall and the Natio Anthem. The broadcast is in Dan throughout, but an English identificat is given when the station closes at 8 p

FLASHES FROM EVERYWHERE

GERMANY'S Deutsche Welle, Cologne, is now using an additional 20,000W transmitter, and the new schedule which covers broadcasts for March is as follows: To Far East, 8.30-11.30 pm on 15,275, 11,795 Kc; Near East, 12.30-3.30 am, 11,795, 7290 Kc; Africa, 4.0-7.0 am, 11,795, 7295Kc; South America, 8.0-11.0 am, 11,795, 7290 Kc; North America, 11.30 am-2.30 pm, on 7290, 5980Kc.

PHILIPPINES relay of the Voice of America, located at San Fernando, Philippines, using 35,000W, now operates transmitter Philippines-1 on 11,790Kc, 8.0 pm-1.0 am, while the Manila transmitters, using 50,000W, operate Manila-2 (9530) 8.0-11.30 am, -2 (9535) 7.0-9.30 pm, -1 (9535) 11.0 pm-1.30 am, -3 (11,895) 10.0-10.30 am, -1 (11,895) 7.0-11.0 pm, -3 (15,245) 7.0-7.30 pm, 9.30 pm-1.30 am, -1 (17,760) 10.0-10.30 am.

OKINAWA'S Voice of America relays, carried on broadcast on the million-watt transmitter, on short-wave uses 35,000W and is now on 6145Kc 8.0 pm-12.45 am, while the Colombo relays are now on two frequencies, 9570Kc 11.30-3.30 am and on 11,875Kc 11.30 pm-3.30 am.

UGANDA'S new broadcasting service, the latest of Britain's African colonies to be provided with a broadcasting service, is now operating on a temporary schedule. but is expected to be in full operation this year. The station is organised by BBC personnel, including Director of Information Mr. H. White and Chief Engineer Mr. Graham Phillips, a former BBC engineer. Graham Phillips was a close friend of the writer's when Phillips was attached to the Overseas Engineering and Information section of the BBC and handled many GOS details. The Kempala, Uganda station, is to use 7500W transmitters on 3340, 5026 and 7110Kc. The broadcast band outlet, using 1000W on 971Kc, has been operating for several months on a short schedule.

VIETNAM'S Radio Laos operates on 7215Kc with 1000W, according to verification letter from the chief engineer, Mr. T. O. Veravong, Radio Laos, Vientiane, Laos. The schedule is 11.0 am-noon, with news in English at 11.5 am, Vietnamese 11.15 am, Laotian 11.40 am and 10.0 pm-12.30 am. The program includes local news at 10.40 pm, world news 11.0 pm, news in French midnight and in Thai 12.15 am. Two new high-power transmitters, which will use two supplementary frequencies beside the present one is reported by Universalite.

VIETNAM's Cambodia, one of the three States of the Vietnam Republic, has a radio station located at Phnom Penh and details from the chief engineer, Mr. Oung-Sarun, lists the frequencies as 6090Kc with 1000W and 1433Kc with 500W. The station operates 9.0-10.0 am, 2.0-4.0 pm and 8-11.15 pm. The evening program consis of American music 8.0-8.15 pm, Cambodi orchestral music 8.15-8.45 pm, news Cambodian 8.45-9.0 pm, Cambodian mu 9.0-10.0 pm, news in Cambodian 10.0-10 pm and music from Radiodifusion Fra coise to sign off at 11.15 pm.

BBC's latest frequency changes inclu the use of four new frequencies in t 41, 16, 13, 11 metre band, the form channels being outside the new sho wave bands. GRS (7135) moved fr 7075Kc, GRQ (17,740) from 18,035, G (21,630) from 21,750 and GSK (26,0 from 26,100.

DJAKARTA'S use of 9865Kc in t morning transmission to Europe and N Zealand provides fair signals, but not good as the 11.795Kc outlet. Both fr quencies are heard with English progra 5.0-6.0 am, during which period, at le in this area, interference is received fr ZL3 (11,780).

RADIO VIENNA, Vienna, Austria, ve fied with a new verification card, repo the NZ DX Times. This colored card h been received by New Zealand listene after a long delay, but the station autho ties report that verifications had be held and later returned by the milita administrators to the station. The matt has now been clarified and listeners w be assured of faster verification of repo to Radio Wein in the future.

RADIO CEYLON

Four networks now carry the progra of Radio Ceylon. They are the Nation (Sinhalese), National II (English), Nation III (Tamil) and the Commercial Servic Frequencies in the 60M band are no used by all four networks for the la period they broadcast each evening. Rad Australia, in releasing this schedule, r ported that Radio Ceylon, with Comme cial Service broadcasts had been receiv on 11,715 and 11,975Kc at 9.30 pm, b these frequencies have now been dropp in favor of the scheduled 6006 and 95 Kcs outlets. The complete schedule is:

Network 1: 11.0 am-12.30 pm, 9.30 pm 2.30 am (4900), 4.30-5.30 pm (6075) wi 7500W. Network 2: Noon-1.0 pm, 5.0-6 pm, 10.0 pm-2.30 am (5025), 1Kw. Ne work 3: 11.0 am-12.30 pm, 4.30-5.30 p 10.30 pm-2.30 am (4967) 7½Kw. Comme cial Service: 8.30 pm-3.30 am (4870) 7½K 11.0 am-3.30 am (6006) 7½Kw, 10.30 pm 3.30 am (11,975) 35 Kw to India, 11.30 a 2.30 pm (7190) 7½Kw and 10.30 pm-2.30 a (7190) 7½Kw, 11.30 am-2.30 pm (9520) Kw, and to East Africa, 3.0-4.30 pm, 8. 10.15 pm on 17,820Kc. This latter tran mission is well received here with ne at 8 pm.

THE HAM BANDS WITH BILL MOORE

NSW 144MC. FIELD DAY IS SUCCESS DESPITE RAIN

Many radio amateurs are attracted to the high frequency bands where there is more scope for experimentation than on the other bands. They still, however, enjoy days in the field with operating as the main feature, and these events are always well supported.

HE NSW UHF section State-wide 144 Mc field day was held on the Sunday of e Australia Day weekend, January 31. spite the inclement weather many ex-llent contacts were made, some over ng distances.

The main problem facing participants as whether they would be able to reach eir selected locations. To climb to some our mountain tops is a sufficient motor al under any conditions.

Heavy rain was recorded just prior to the y and often makes the tops inaccessible. tivity of some stations was limited—in e south stations could not be taken into e field.

Most stations, however, were on location rly on the Sunday morning. Farthest st were Norm Skulander, VK2JW, and n Kirby, VK2ALX, on Mt. Canoblas ar Orange, 140 miles west of Sydney. the south Arch Cox, VK2GU, of Can-rra, was active.

OST NORTHERN STATION

Farthest north was Ken Mitchellhill, K2ANU, at Muswellbrook.

All these stations contacted Sydney sides the stations in the field.

Unfortunately Ross Weeden, VK2PN, d Geoff Page, VK2BQ, who were to ve made the trip to the Granites out m Tumut were prevented from setting t due to rain.

At a distance of 180 miles from Sydney y would have provided the DX interest.

Most successful station in the field was nn Miller, VK2ANF, operating from Mt. mah in the Blue Mountains. He was isted by Roy Hart, VK2HO, Perc Healy, K2APQ, and Es Griffiths. A total of 32 ferent stations was contacted using three over three array. Contacts in-ded VK2JW, 90 miles west, VK2ANU, miles north ,and VK2GU, 150 miles to south.

The VK2WI 1930 hours UHF broadcast s originated from this location and roadcast on 50 Mc by VK2HE in Syd-y and VK2AGY in Newcastle. It was most effective coverage ever obtained a 2WI UHF broadcast, 100 miles in al" ections.

Harry Solomons, VK2AJZ, operated m Mt. Pillington also in the Blue untains, and recorded 19 different con-ts.

Longest distance covered was to VK2JW Orange. Both VK2GU and Newcastle tions were heard.

ATEN BY RAIN

Morry Lapthorne, VK2HL, and John rnthwaite, VK2ATO, who are trout ning near Oberon journeyed to the nmit, and contacted Sydney stations, were driven back by the rain. On following day VK2ATO climbed Mt. do with his walkie-talkie equipment, e was successful in working Sydney h only 6 watt input, over some the worst country in the Blue untains. Ted Isaacs, VK2ABO, was ated at Mt. Grey near Goulburn but ld only hear VK2GU . After a journey r selected short cuts, some of them rly impassable, he contacted a num-of Sydney stations on the trip back. Many stations proceeded to elevated itions around Sydney and stations at ne in Sydney and Newcastle plus 2LZ and VK2JX at Wentworth Falls, Oft up in the Blue Mountains, greatly sted to make the day a success. number of stations farther west were active this year, but the day created nendous enthusiasm among the UHF g.

he day was held over from the Six-ur Day weekend and the UHF section is to be congratulated on the organisation of the field event.

After the official examination of the logs, and provided at least 75 pc of them are received, prizes will be awarded to the following:—

The station located farther than 55 miles from Sydney making the greatest number of contacts.

The station making the contact over the longest distance. (Either fixed or portable).

The portable station making the greatest number of contacts.

The duration of the contest period was 13 hours, and serial numbers had to be exchanged to score points.

The opening session of the NSW Division's Fourth Annual Hamfest comprised the January monthly meeting held as usual at Science House, Sydney. The attendance was in excess of 100 with visitors from the country and interstate comprising VK4MD, VK4ML, VK2AQS, VK2AJO, VK2DY, VK2AQD, VK2APE, and VK2AXS.

Lecturer for the evening was Vaughan Wilson, VK2VW, Federal contest manager.

He took for his subject "Communication Receiver Design for the Ham", and described his idea of the ideal receiver — Broadband RF, Triode Mixer, IF crystals, &c. Many extremely interesting points were brought forward and created lively discussion which continued into the night in the precincts of Science House. This interesting lecture was of the type which is very popular among amateurs.

The second session commencing on the Saturday afternoon was held at the Sydney Showground.

Over 100 amateurs gathered at the RAS general office to participate in the competitions and general program.

The opening lecture was presented by Dr. Leo McMahon, VK2AC, who discussed crystal filters for amateur receivers. With the aid of test equipment he demonstrated visually single and double filter effects, notches, slopes and other features.

It was a very practical approach to crystal IF filters and associated problems.

Leo extolled the virtues of double crystal filters compared with Q5'ers and expressed the opinion that they were more serviceable in amateur receivers. They were very useful for telephony reception, and eliminate the annoying ringing inherent in single crystal filters.

Afternoon tea prepared by Mrs. VK2YC, VK2ARW, VK2AQS, and VK2DY was then served.

The second lecture was then given by Harry Solomons, VK2AJZ, secretary of the UHF section who described and demonstrated a grid dip oscillator.

The GDO used a magic eye tube instead of the normal moving coil meter as an indicator. The eye is very sensitive, more so than the usual meter available.

EVENING SESSION

The gathering was then adjourned for tea, and the evening session which followed was devoted to general topics, and the distribution of the many prizes, the later ranging from a portable broadcast receiver to a brig key.

The State president Jim Corbin, VK2YC, then presented the country zone officers in attendance including Noel Hansen, VK2AHH, North Coast, Eric Fisher, VK2DY, South Coast, Jim Edge, VK2AJO, South-western, Bob McPhee, VK2AQD, North-Western, and Hunter branch representative Bill Hall, VK2XT.

Donations of prizes for competition were made by Kreisler Radio, B/C receiver, Philips Electrical Industries Pty. Ltd., two QQE03/12 UHF Valves, R. H. Cunningham Pty. Ltd., xtal microphone, and O. T. Lempiere Ltd., reels of solder.

Trade exhibits were presented by R. H. Cunningham Pty. Ltd., United Radio Distributors Pty. Ltd., Angus and Robertson Pty. Ltd., and Amalgamated Wireless (Australasia) Ltd.

The display gave country amateurs an opportunity to examine equipment and radio books not readily available to them.

The annual hamfest is fast becoming a very popular feature of institute affairs.

(Continued on page 101)

BERU CONTEST ONLY MEDIOCRE

The 1954 BERU contest which ran for 48 hours on January 30 and 31 was reasonably well supported, despite exceptionally poor propagation conditions. From 1000 hours local time, Australian and New Zealand stations could be heard battling, but interest had waned somewhat by the same time on the following day, as the number of stations available for contact was reduced.

A few ZS's and VQ's appeared on both afternoons.

Generally peaking around 1600 hours EAST they were rather weak on the east coast. The conditions in the evening on 14 Mc compared with previous weeks were poor, too, and by 0130 hours only an odd Asian and African remained audible. Morning DX at this location was restricted to an odd VE.

It was hoped by moving the contest date forward in the year better conditions would be experienced.

Generally signals were weaker than last year, especially those from Europe and the Middle East. Static too, was very heavy on the lower frequency bands and caused considerable din on the Sunday.

New Zealand stations reported little in the way of good signals. Stations in the antipodes operate at some disadvantage in this type of contest during poor propagation conditions.

Contacts are thereby restricted to the VK/ZL prefix zones plus an odd VS or VU, while stations in other countries have a greater number of zones within working range.

It it difficult to decide whether DX contests will ever attain the popularity of a few years ago, amateurs will have lost the art of contacting twenty DX stations an hour.

NOVICE LICENCES

Novice licences in the US issued in the first year of operation of this class of licence tallied 13,000, with a considerable drop to 9400 during the second year.

The ARRL is concerned with this reduction in licences as since the inception of the novice class, a great amount of publicity has been given this licence as a method of entering the ranks of the radio amateur.

Publicity was at an unprecedented level, and in one particular case 250,000 copies of a special sheet were distributed through schools, boys' organisations, hobby exhibitions, &c. Every opportunity was used to interest the greatest number of persons possible.

Reviewing the subject of publicity as a means of attracting newcomers to cover the necessary growth of the hobby, it is considered that personal contact is the best method.

(Continued on Page 101)

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For the radio repair man, amateur experimenter, motor mechanic and electrician. This pocket size multimeter is ideal. DC Voltage readings 0-15, 0-150, 0-300, 0-600. Ohms scale 0-10,000 ohms. The dial is exceptionally easy to read and the meter will stand up to any amount of hard work.

Price £3/19/6. Weight 1lb.

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as illustrated are available in the following Band Set, Band Spread, B.F.O., Brodacast, Crystal, C.W., Filament, Gramophone, Mixer, Modulator, Monitor, Phone, Phones, Pick-up, Power, Radio Receiver, Record, Rectifier Short Wave Speaker, Tuner, Transmit, Wave Change, Off-On, Aerial, Earth. Note.—Aerial and Earth are circular plates. These are ideal for the home builder and amateur when building amplifiers, communication sets, transmitters, etc. Worth 11d each.

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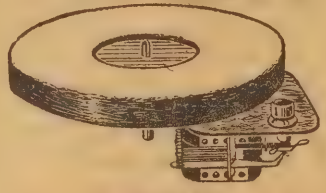
Assorted types.



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Weight 7lb.

Our price £5/10/-.

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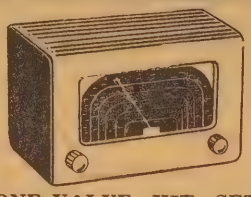

ONE-VALVE KIT SET FOR THE LEARNER

Although this little set is quickly and simply built, it looks like a factory built job. The wooden cabinet is covered with burgundy leatherette and the dial has all Australian stations marked in different colours. Parts are mounted on a wooden base board and anyone can built it if they can use a soldering iron. Circuit diagrams, wire, solder, etc., supplied.

Price for complete kit of parts including Valve, Headphones and batteries at normal price is £8/5/-.

Our price is £5/19/6.
Weight 9lb 2oz.

A two valve model similar in appearance to the one valve but works a built-in loudspeaker.

Price £8/19/6.

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1. AT5—AR8 Remote Control Units consist of double bank 3 position Oak Wafer Switch with indicator knob and a terminal strip with 20 screw type terminals all housed in metal box, 3in x 6in x 1½in. Worth 15/- ea. **Our price 3/6.** Weight 2lb.
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3. **884 Gas Triode Valves.** Brand new. **28/6.**
4. **Junction Box 10A/11986.** Housed in metal box 4 x 3 x 2 inches with a PMG type 3 position multi contact toggle switch, coupling transformer, terminal strips and 4 pin plug. **Price only 7/6 each.**
5. **Reel Control Boxes,** BC461. A rev counter is fitted to each of these. It will count up to 999. A 3 pole 3 position wafer switch with metal indicator knob and pilot lamp holder and 9 pin plug, all in metal box, 5 x 3 x 1½ inches. **Price is 25/- each.**
6. **Closed Circuit Jack.** When phone plug is out the contacts are connected together. When plug is in the contacts are open.
7. Transmitting Crystals frequency 4495KC. **9/6 each.**

7A. Few only. MN26C Radio Compass Receivers. 150-1500 KC with 28 volts DC Power Supply. Brand New with Valves 19 gns. less Valves **£12/10/-.**

8. **Under Car Aerials.** Complete with lead-in and plug. Worth £4/10/-. **Our price 35/- each.**

SPECIALS

9. **Whip Aerials,** suitable for windscreen mounting or side mounting with suction cup and lead-in and plug. Worth £3/10/-. **Our price 30/- each.**
10. **Power Control Boxes,** BC958A and BC965A Selector Control Boxes Combined, power control box size 6 x 3⅝ x 2in. Selector control box, size 4½ x 2¼ x 1¾in. Each pair units contains 1 phone jack, 2 Cutler-Hammer N.P. toggle switches, 1 5-pin heavy duty plug and socket, 1 7-pin heavy duty plug and socket and 1 6-position wafer switch with pointer knob. Well worth 25/-. **Our price 6/6.**
11. Nylex Tubing in 6-foot lengths. Sizes 12 mm, 2/- length; 18 mm, 3/- length; 20 mm, 4/- length.
12. .1—2000 V. Wkg. Condensers Block. **3/3 each.**
13. .1—4000 V. Wkg. Condensers Block. **4/6 each.**
14. .5—8000 V. Test Oil filled Condensers. **4/6 each.**
15. Oak type switches, 1 pole 3 position and 1 pole 2 position. **2/- each.** With long shaft.
16. 4 x 500 mfd PV Electrolytic condenser banks. Worth 25/-. **Our price 5/-.**
17. Transformers for 400 cycle supply. Assorted types only, **2/- each.**
18. 50/50 Resin Cored Solder, 1½oz packets. **2/- each.**
19. **Car Radio Extension Rods,** 2 piece type extend to approximately 5ft 6in. Chrome plated, ideal for side mount and bumper car aerials. Worth 35/-. **Our price 10/- each.**
20. Throat Microphones, brand new, sacrificed for special price. **Only 5/- each.**
21. Microphone Adaptor M299, designed to adapt the throat mike to the amplifier input. **Price 5/- each.**
22. Cord assembly to connect the throat mike to the adaptor, has the necessary cords, plugs, etc. **2/6 each.**
23. CD508A Cord Assembly with phone plug, 2-pin socket and press to talk switch. **Price 3/6 each.**
24. Dry metal Rectifiers, meter type, suitable for 0-1 or 0-5 mA meter. Brand new. Worth 37/6. **Our price 25/- each.**

NOTICE

All parcels sent registered post unless otherwise stated. Postage or freight must be included with order.

547 ELIZABETH ST., MELBOURNE ALSO AT — ALBURY ARARAT BAIRNSDALE BALLARAT BENALLA BENDIGO BROKEN HILL COLAC DANDENONG ECHUCA SALE FRANKSTON GEELONG MILDURA SHEPPARTON ST. ARNAUD WAGGA WANGARATTA WARRAGUL

This can be best effected through local dio clubs, by Morse and theory classes, nd by assisting local enthusiasts.

It was generally considered that the ovice classes would be the means of eeping the population of radio amateurs a healthy level, and provide the neces- ry growth without any further action.

It is quite apparent that the amateur ill still have to assist in many ways all rospective newcomers.

NTO CW SECTION

Wtih the loss of 50 Kc from the 7 Mc and telephony stations are gradually eeping toward the 7000 Kc end of the and into the recognised CW territory is hoped that the voluntarily resognised mits of telephony operation will not e forgotten. These remarks also apply the 14 Mc band where a number of elephony stations are operating between .000 and 14,100 Kc.

In view of the reduction in band idths and general changes in the ratio telephony to CW stations operating, a eview of these limits might be con- dered.

One of the worst operating habits heard for a long time is the slow QSY of one of our leading telephony ex- ponents with transmitter at full power.

"Follow me down" has been observed a number of occasions with little egard to other stations working on the and.

Although the DX station being contacted annot hear any interference when the ation finally settles on the selected fre- uency, this does not mean the channel clear. There certainly was no check accordance with our regulations.

The 7 Mc band has been providing some xcellent DX during the evenings, static ermitting. Signals are mainly from sia and the Pacific and among them ere JZOKF (QSL via Allan, VK9YY), RIAA, 7030 Kc—2150 hours, plus VS6's nd JA's, KC6AF and KC6AA. UA6FA as been running at S8 calling WESM, few W stations answered but there was o response.

NEWS IN BRIEF

After 14 years Arthur Milne, G2M1. elinquished his column in the RSGB ulletin, "The Month on the Air"

Arthur is now president-elect of the ociety and his duties left him little time follow the bands and news thereon. is column was always topical and was uoted authoritatively in overseas mateur radio journals.

His successor is Stan Herbert, G3ATU.

Stan has for some years contributed The Amateur Bands Commentary" to he English publication "Radio Amateur". lthough he has only graduated to the mateur ranks postwar, he is very conver- ant with DX and conditions on the HF ands He was one of the first holders f the Empire DX certificate.

The following are recent changes to ddresses of International QSL Bureaus. ists recently published should be mended to cover the following variations' Bulgaria: Box 830, Sofia.

Japan: J.A.R.L., Box 377, Tokio.

Malaya: QSL Bureau Manage, P.O Box 00, Penang.

Netherlands Antilles (Aruba): Postbox , San Nicolas, Aruba.

Netherlands Antilles (Curacao): Post- ox 383, Willefstad, Curacao.

Philippine Islands: Elpidio G. de Castro, hilippine Amateur Radio Assn., 2046 aft Av., Pasay City.

Don't forget the WIA's North Coast one's convention to be held at Easter t Urunga, April 16, 17, 18 and 19.

This event is extremely well known for s entertainment and educational value. full program will be listed later.

Zone officer Noel Hansen, VK2AHH, t Kempsey, is responsible for the gen- ral organisation, while Crief VK2XO or ny of the North Coast gang will supply etails. Keep Easter clear for Urunga.

Chris Cowan, VK2PZ, of Aberdare, lec- ured at the February meeting of the unter branch of the WIA, and covered ecent developments in class B amplifier esign. 25 watts from push-pull 6V6's as one theme. Chris brought forward any interesting points on modulators nd amplifiers.

The branch has lost one of its stalwarts n the transfer of Jack Hill, VK2ADT, to nverell.

Jack, operating from Cessnock through the years has kept the town on the map from an amateur radio angle. Always experimenting, he was active on all bands from the UHF's through to 3.5 Mc.

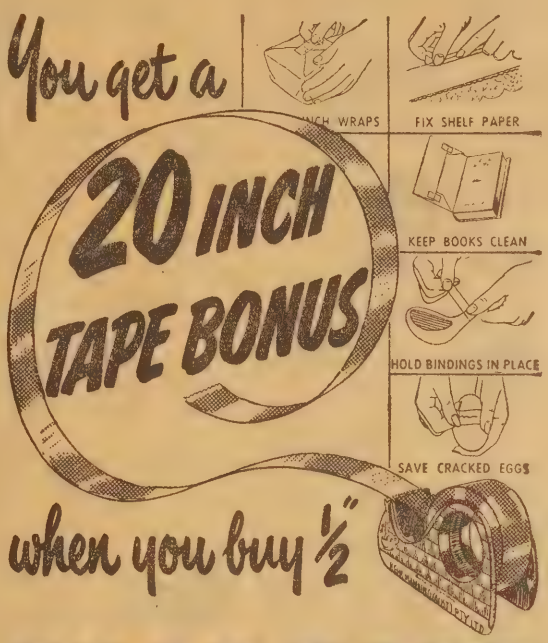
The March meeting of the NSW UHF section will be held at Science House on March 5. Main business will be the elec- tion of officers for the ensuing year

A debate will follow the election. At the time of writing the "Kista Dan" with the Australian Antarctica Expedition reached their base in Antarctica. Amateurs are anxiously awaiting a signal from Bill Storer, VK1EG.

There will be a race for the first con- tact. Interest is so keen—perhaps a schedule will be arranged via other chan- nels?

SM8LS has been heard at odd times when European signals are not usually heard. Quite a few stations have spent time calling him, but on making contact they find he is mobile marine in the Pacific. No doubt he obtains more con- tacts by not using the usual stroke MM, but it is rather annoying to waste time hoping to contact Europe at an unusual time.

Fortunately he is the only mobile marine station using such tactics.



BEAR TAPE
BRAND

Your storekeeper uses this width . . . so follow the lead of men and women who use tape most. And, in addition, "BEAR TAPE" seals tighter, mends better, and holds faster, because it's made here for Australian conditions.

"BEAR" ½" x 200" rolls, in gaily coloured plastic dispensers, cost only 1/9 each everywhere.

BEHR-MANNING, makers of the famous "BEAR TAPE," are also the largest manufacturers in the Southern Hemisphere of high-quality Sandpapers, Pressure-sensitive Tapes, Adhesives and Coatings, as well as being makers of "PROOFKOTE."

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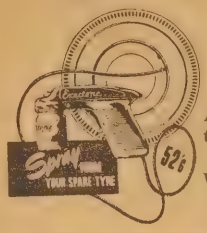
512 Elizabeth St., Melbourne, C.1.
'Phone: FJ5904. Just 4 doors
Mail Orders Carefully Packed
Please Add Freight or Postage

SPRAY YOUR CAR, TOYS, HOBBIES, FURNITURE



52/6

Spray from your Spare Tyre

An Ideal Tool for touching up damaged paintwork. Will spray Lacquer, Paint, Enamel.

Stock and Die sets, ¼in., ⅜in. and 1in. water pipe. **£4/19/6.**

IN FIRST CLASS ORDER DALTON COMPUTERS IDEAL FOR AERO CLUB. 45/-

Aircraft Bomb Hoist ideal for garage work. **£6/15/-**

63/6

Complete with flex and switch.

At Last! The spotlight you have been waiting for.

Fitted with genuine American sealed beam 6-volt globes. No motorist or boat owner should be without one.

Ideal for Fox or Rabbit Shooting

BALL AND SOCKET INSPECTION MIRRORS

8/9 each

Ideal for mechanics, radio repairs, dentists, etc.

AMERICAN ELGIN 8-DAY AIRCRAFT CLOCKS.

FIT TO YOUR CAR OR TRUCK.

£5/5/-

The name of Elgin is world renowned and made by the best manufacturer in America.

ELECTRIC ENGRAVER

What everybody has been waiting for. An Electric Engraver that works off your car battery.

Ideal for name tags, dog collars, plant labels, etc.

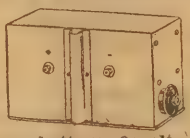
Engraves anything in metal.

29/6

Engrave your name on all your tools. Marked tools are never stolen. No Garage should be without one.

COMPLETE BATTERY CHARGER

Fitted with Brand New English Selenium Rectifier.



Works off 230v. Household supply.

Charges any battery, 6 volts at 4 amps. £6/15/- complete. Also available, 6 or 12 volt Chargers combined. Charge 2 amps, £7/15/-. Brand new 6 volt, 2 amp Chargers, complete, £5/2/6.

English Motor and Blower, 24 volts.

Will work off any Lighting Plant.

39/6

Larger size also available that will work off 12 or 24 volts £3/15/-.

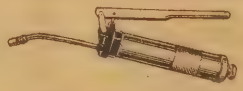
AMERICAN VACUUM or AIR PUMP

Builds up air pressure to 20lb at 1000 R.P.M. develops up to 120lb of hydraulic pressure; will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems **£3/10/-**

WATCHMAKERS AND INSTRUMENT MAKERS

English Tweezers . . . . . 6/6 and 5/6
Eyeglasses . . . . . 6/6 and 8/6
Extra strong double lens Eyeglasses, 15/-
SCREWDRIVERS, set of 5 . . . . . 13/9

BRAND NEW LEVER TYPE GREASE GUNS WORTH £4/19/6.



59/6

Ideal for all types of Trucks, Tractors or Cars. 7500 lbs pressure.

45/- COMPLETE

Professional Magnifier with Stand and Extension Arm. Useful Doctors, Painters, Mechanics, Engineers, Photographers.

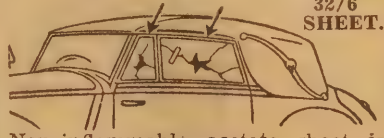
ENGLISH ARMY SPOTLIGHTS

IDEAL FOR SHOOTING. FIT ONE TO YOUR CAR.

6-volt **37/6** 12-volt **25/-**
Fitted with Mirror Reflector.

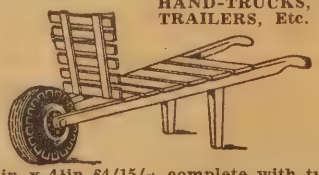
Replace those broken side curtains with cellulose acetate which takes the place of celluloid and lasts four times longer. Will not discolor.

32/6 SHEET.



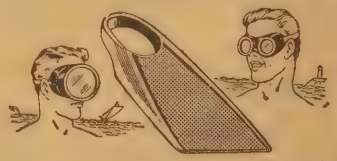
Non-inflammable acetate sheet is recommended for all types of side curtain. Sheets are 20 thousandths of 1 inch thick. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

Brand new AEROPLANE WHEELS
IDEAL FOR WHEELBARROWS, HAND-TRUCKS, TRAILERS, Etc.



10½in x 4½in £4/15/-, complete with tube.

UNDERWATER SWIMMING AIDS AS USED BY ARMY FROGMEN AT NEW REDUCED PRICES



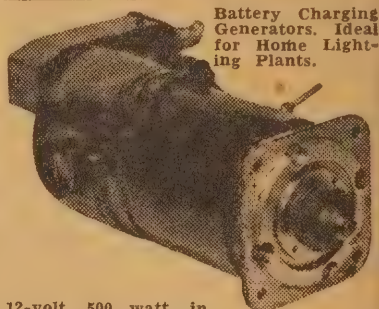
Fins size 8-10, 25/9; 6-8, 25/9; 3-5, 22/6; 1-3, 22/6. Goggles, 15/6; Masks, 6/11; Snorkels, 10/6.

LUCKY PURCHASE. A FEW ONLY
½in 230 VOLT ELECTRIC DRILLS

English Wolf £25/6/-

Black and Decker £22/16/-

BE EARLY THESE WON'T LAST LONG.



Battery Charging Generators. Ideal for Home Lighting Plants.

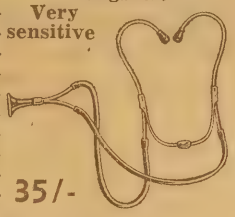
12-volt, 500 watt, in good working order £5
12-volt, 500-watt, new £7/10/-
24-volt, 1000-watt. Brand new, £12/10/-
200 amp welding Generator. Made in America. Brand new £50
Tested and in perfect order . . £35
Be early these won't last long.

STORES

512 Elizabeth St., Melbourne, C.1.
From Victoria Street. 'Phone FJ5904
and Efficiently Despatched
Include State in Address

MECHANICS' STETHOSCOPES, Ideal for Testing Engines.

Very sensitive



35/-

SPECIAL OFFERS

American Schrader tyre pumps, work from your spark plugs, **39/6.** Fish pond aerators, work from 230 volts, **57/6.** Commando Telescopes, ground lens, **45/-.** Sampson low pressure Spray Guns, **£6/17/6.** Micro amp meters, suitable for making photographic light meters, **17/6.** Aircraft Pressure Gauges, 0 to 20lb pressure, **22/6;** 0-200lb, **25/-.** Pressure type Oil Cans, **15/6.** Aircraft Rev Counters, extra long lead, ideal for boats or cars, **75/-.** All Steel Mechanics' Tool Boxes, lift out tray, **32/6.** Cathode Ray Tubes, complete in case with controls, **55/-.** Pocket Magnifying Glasses, 8 mags, **8/6;** 10 magnifications, **12/6.** Metal Drill Sets, 1-16 to 3-16, 9 Drills for **3/6.** Swiss Music Box Units, can be fitted into any box. Make yourself a Music Box, **30/-.** Many tunes available, including The Harry Lime Theme, The Merry Widow, One Enchanted Evening, The Wedding March, Teddy Bears' Picnic, etc. 24-volt motor and hydraulic pump, capacity 3½ gals. per minute, **£3/15/-.** Automatic actuators with 24-volt motor geared with telescopic shaft 400 r.p.m., can be used as fence post borer, etc. **55/-.** Hydraulic pumps, 1200 p.s.i., 8 1-3 gal. per min., **£18/18/-.** 5 gal. per min., **£7/10/-.** Generator Test Meters, 35-0-35 amp meters, 4½in dial, **45/-;** 0-10 volt meters, 4½in dial, **45/-.** Loading Resistors can be supplied to make meter read 10.20 at **12/6.** Medical Scalpels, many uses, photographers, etc., **6/6.** Shaded Pole Induction Motors, made by Hoover of England,, 230 volts, AC. Ideal for Projectors, Tape Recorders, Fans, etc., **£4/19/6.** SAE open end Spanners, 6 to set. **24/6.** Whitworth, 4 to set, **18/6.** 2½in Paint Brushes, set in rubber, special price, **10/6.** Brand new 7-8in Spark Plugs, suit most old type cars, **2/6** ea. Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, **39/6,** 230 volts input. Low pressure Spray Guns, **39/6.** Army Steel Tow Ropes with looped ends, **17/6.** Army Tripod for photographic work, levels, etc., 41in long, **22/6.** Whitworth Spanner Sets open one end, ring the other, **25/-.** 6 spanners to set.

Genuine American hand operated Klaxon Horns. Ideal for trucks, factories, boats, etc. Brand new, £4/4/-.

R.A.F. LEATHER FLYING HELMETS

35/- each Intercommunication Tubes 50/- set.

MK8 Goggle 48/6 Pr.
MK7 Goggles 37/6.

WOOL LINED FLYING BOOTS £5/15/- pr.

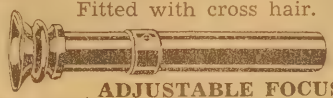
FOR MOTORIST

17/6 Special Offer 17/6

2 genuine American Herbrand spanners, ¾ x 7-8, 1 1-16 x 15-16. 1 pair English diagonal cutters. 1 screwdriver.

ARMY FOCUSING TELESCOPE

Easily converted for use on dumpy levels.
Can be used as a rifle sight.
Excellent magnification .. **£4/19/6**
Fitted with cross hair.



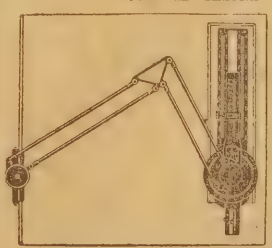
ADJUSTABLE FOCUS

24-VOLT MOTOR COMPLETE With Fuel Pump

Ideal for Caravans. Takes the place of Hand Pumps. £5 each.

Many uses on the Farm. Will transfer Petrol or any Liquid from Drums, etc. Will work from 24 or 32 volts. AC or DC.

R.A.F. PLOTTING BOARD WITH ARM



Bakelite Base. Draws Angles Parallel or Vertical

70/-

IDEAL FOR ENGINEERS, STUDENTS, ETC.

LUCKY PURCHASE OF INFLATABLE RUBBER AIR BEDS

Ideal for Caravans, Cars, etc. Ideal for Hikers.

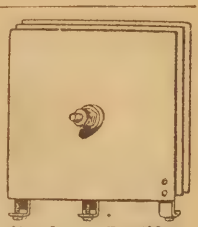
Take one to the beach. Will float in water, **£5/11/6.**

SPECIAL DISPOSALS METER OFFER.

0-10 amp meters, AC-DC, 2½in dial, **45/-**
0-1 milliamp, 2½in dial **37/6**
Weston 0-50 Volt 0-100 amps combined M/coil, **£3/10/-**
English 50-0-50 Ammeters, M/Coil **37/6**
English 20-020 Ammeters, M/Coil **37/6**
English 0-20 Voltmeters, M/Coil .. **25/-**
English 0-40 Voltmeter, M/Coil .. **25/-**
English 0-300 AC-DC Voltmeters .. **55/-**
English 0-5 Milliammeters, 2½in .. **27/6**
English 0-150 Milliammeters, 2½in **30/-**
English 0-25 Ammeters, 2½in M/c **30/-**
English 0-10 Ammeters, 2½in dial, Moving Coil **45/-**
English 0-30 Voltmeters, 2½in dial AC-DC **42/-**
Eng. 0-40 Ammeters, 2½in dial AC-DC **42/-**
English 0-50 Ammeters, AC-DC .. **42/-**
Eng. 0-3 Ammeters 2½ dial, AC-DC **45/-**
Eng. 0-150 Voltmeter, 3in Dial, Moving Coil **39/6**
Eng. 0-500 Micro Ammeter M/coil **37/6**
Eng. 0-150 Ammeter, 3½ Dial, AC-DC **75/-**
Eng. 0-20 amps, 2in Dial, M/c **25/-**
Eng. 0-1½ Milliamps, 2in Dial, M/c **19/6**
Eng. 0-20 Milliamps, 2½ Dial, AC-DC **17/6**
Eng. Multimeter, reads ohms and volts **35/-**

BRAND NEW ENGLISH RECTIFIERS

Make yourself a Battery Charger.
12v. 2 amp. 25/-
6v. 5 amp, 50/-
12v. 5 amp, 79/6
12v. 3 amp, 45/-
6v. 2 amp, 24/6
6v. 4 amp, 45/-

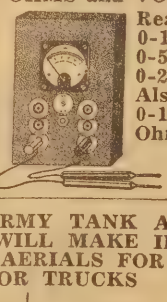


Transformers to suit above Rectifiers, 2 amp, 37/6; 6 volt. 5 amp, 45/-; 12 volt. 5 amp, 55/-.

AIR MIN. MULTI TESTER TESTS OHMS and VOLTS

COMPLETE WITH TEST PRODS

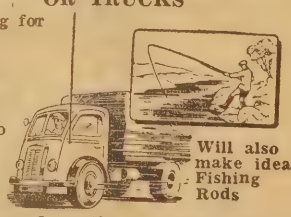
£5/17/6



Reads 0-10 Volts, 0-50 Volts, 0-250 Volts Also 0-10,000 Ohms.

STEEL ARMY TANK AERIAL RODS. WILL MAKE IDEAL RADIO AERIALS FOR CAR OR TRUCKS

Too long for postage. Advise nearest railway station.



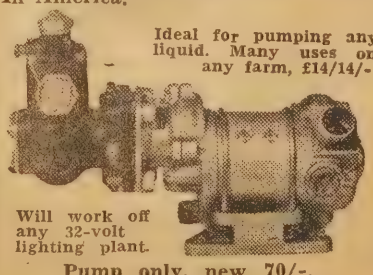
Base to suit Aerial, 9/6 each.

Will also make ideal Fishing Rods

12ft long, 3 sections. Each section 4ft, **22/6.** 8ft long, 2 sections, **15/-.**

Aircraft 24 volt Motor complete with 400 gal. per hour Pump. Made In America.

Ideal for pumping any liquid. Many uses on any farm, **£14/14/-**



Will work off any 32-volt lighting plant.

Pump only, new 70/-. In good working order, 55/-.

ACE RADIO

PHONE LA 3845

136 VICTORIA RD. MARRICKVILLE, SYDNEY, N.S.W

EVENINGS & WEEKENDS: "KALUA," COLLAROY ST., COLLAROY — XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD, TRAM AT DOOR, STOP No. 42.

Brand NEW AR8-AT5 Equipment

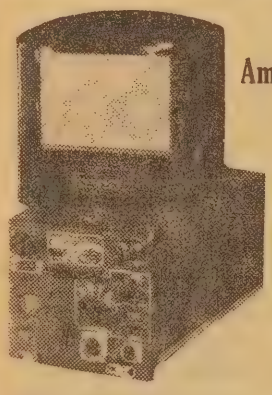
in Original Factory Tropic Proofed Cases

The Receiver, Transmitter, Aerial Coupler & Shock Mounts and Circuits

£57/10/-

Will Separate Receiver, £32/10/-; Transmitter, £25; A.C.U., £3.

Packing FREE! for Air or Passenger Rail. Goods Rail add 10/-.



A.R.B.

American Communications RECEIVERS

195KC to 9.025MEG

Complete with Valves. £19/10/-

Converted, Air-tested. Complete with Power Supply and Speaker.

240V AC £29/17/6
24V DC £27/17/6
12V DC £32/17/6
32V DC £28/17/6
6V DC £37/10/-

MARCONI 1155

Communications receivers

200K.c. to 17.5megs

10 VALVE. 5 BAND. DUAL RATIO DIAL CALIBRATED FOR ALL BANDS.

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PERSPECTOGRAPH FOR SKETCHING

ave you ever wanted to sketch building or get a scene but een stumped because you can't em to get the proportions ght? This simple perspecto- aph may be just what you're looking for.

can reduce the proportions of a distant object to inches or frac- of an inch and these measure- ts can be transferred directly to sketch board.

ne perspectograph is intended to crewed to a tripod stand, and this ne best way to use it.

g. 1 is a view of the instrument us the stand; you will see it ists of a horizontal bar of wood a vertical rod at one end and iding view-point at the other. n the rod are two crossbars, the one capable of movement up or n the rod, and itself fitted with horizontal slides.

ow, suppose you desire to sketch uilding of some kind, say, for nple, a church. Look through eyehole, and arrange the height he tripod until the edge of the r crossbar coincides with what be the baseline of your sketch.

JUSTING CROSSBARS

ide down the top crossbar until front edge appears to touch the nd line of the church. The is marked in quarter inches. d off the distance between the sbars, and draw a line on your r this distance above the base- already drawn.

ise the crossbar to a level equal ne roof of the church, then read the distance as before and draw roof line on the paper.

ovement of the horizontal slides now indicate the width of the rch, and the points on the roof re the steeple rises from.

ne crossbar can now indicate the height of the steeple, and you will have the body of the building drawn in correct proportions. Details are put in the same way, such as windows, &c.

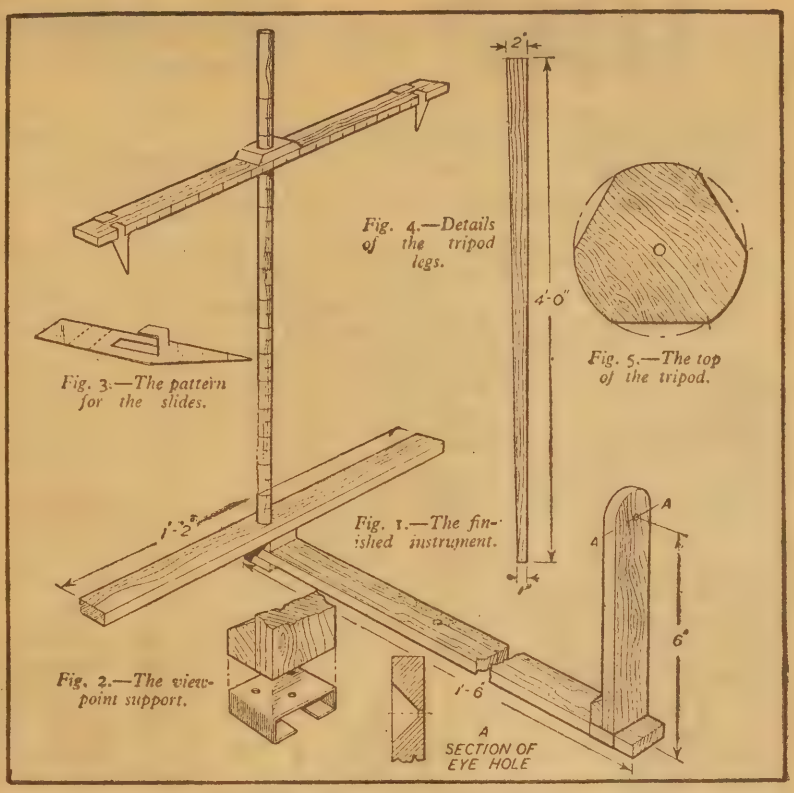

Fig. 1.—The finished instrument.

Fig. 2.—The viewpoint support.

Fig. 3.—The pattern for the slides.

Fig. 4.—Details of the tripod legs.

Fig. 5.—The top of the tripod.

Hardwood is used for the work, 1in. by ¼in. in section, the main dimensions being given in Fig. 1.

The rod is a piece of 3-8in. or ½in. dowel rod, glued in a hole bored in the lower crossbar with an inch projecting below; this is tightly fitted in a similar hole bored in the perpendicular bar.

To provide a firm seating for this part of the rod, a thickening block, ¼in. thick, is glued at the end of the bar.

The rod is accurately marked into inches by lines scratched half-way around, ¼in. lines being a quarter of the way around, and the ¼in. lines being short cuts between.

The top crossbar is similar to the bottom, and should slide easily up and down the rod. This can be effected by lining the hole with a piece of cloth or rubber.

The pattern for the slides at each side is shown at Fig. 3, which should be cut in thin sheet brass and bent to shape.

The edge of the crossbar, facing the artist, should be marked in quarter inches, and numbered in inches from the centre outwards.

The viewpoint support has a small hole bored in, and is screwed to a sheet brass slide, bent to the shape as in Fig. 2.

Bore a hole in the centre of the main bar for a tripod screw, and varnish.

For the tripod stand, cut three legs from wood ½in. thick, to the size in Fig. 4, and at each of the lower ends drive in a wire nail.

Cut off the heads of these nails, and file the shanks to a point, thus forming a spike to prevent the legs from slipping. To the tops fix a 2in. brass hinge.

Now mark out and cut the tripod top as shown in Fig. 5, using wood 1 inch thick. It should then be varnished. The instrument can be taken to pieces and strapped to the tripod for easy carrying.

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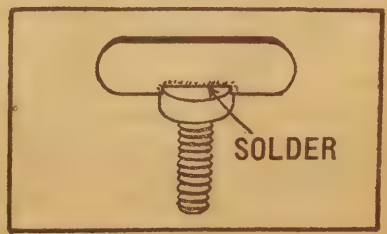

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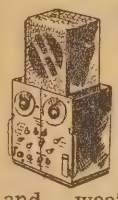

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29/6

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ANSWERS TO CORRESPONDENTS

).L. (Unley, SA) encloses a circuit of power supply for portables with provision for reactivation if required.

A. Many thanks, D.L., for your interesting letter. Your idea could well be of value to other readers and we are adding it with a possible view to publishing it in the "Reader Built It" section at a future issue.

A.V.L. (Gilberton, SA) is interested in the article entitled "Latest Methods in Assembly" of the November, 1953, issue, and asks if the items can be procured easily.

A. As far as we know, A.V.L., no such items are available yet for the experimenter on the Australian market. The article concerned is from an American source and was published as a matter of interest for readers who like to keep abreast with general developments overseas. As a matter of fact, sufficient detail was given in the article to permit experimenters to incorporate some of the ideas in their own assemblies.

W.H.S. (Grafton, NSW) is having trouble with a tone compensating stage and he has forwarded a circuit for our comment.

A. The circuit appears to be quite a standard arrangement and the values are quite normal. Such a circuit, when the full boost position, should start to rise appreciably at about 300 cps and is difficult to explain why your device causes trouble. We have several similar circuits in our files and available through the mail if you would care to compare them. The ideal method of checking is by means of a frequency record or audio oscillator and an output meter, and such arrangement may assist you in tracing the trouble. In the meantime you will doubtless have seen the variable controls featured in the amplifier described in the January, 1954, issue.

R.McK. (Box Hill, Vic.) has built the tape recorder amplifier described in the March, 1953, issue (Tape Recorder No. 2) but is having some trouble with instability.

A. By this time you will have seen a further article in the January issue, which may offer a solution to the low frequency instability. It involves a reduction in the value of coupling condenser between the first two valves. The high frequency whistle on "Record" is likely to be stray coupling between the input and output circuits and we suggest that you examine the wiring around the function switch to see whether isolation or shielding can be improved. A small amount of extra bypassing on one or other of the plates may help matters, although too much will reduce the treble response. The tendency to instability could explain the arcing across the output valve socket, although it is a rather unreal test to put into the microphone. A comparable amplitude of signal is not likely to be encountered in actual service. Don't forget, too, that once a socket has arced across it is likely thereafter to be weak.

D.P. (Brisbane, Q) has built the Reinz Portable described in the March, 1953, issue of Radio and Hobbies, but is not getting very satisfactory performance.

A. It is rather difficult to advise you from the details available, D.P., but we are inclined to suspect that the buzzing sound of which you complain is oscillation. This would suggest that the regeneration control circuit is either not functioning or not being adjusted correctly. This is essential for the correct operation of small receivers of this class and if you are not familiar with this edition we suggest you study some of the articles preceding that in the March issue. It should be possible to control the regeneration at all points on the dial by means of the 100 pf variable capacitor in the loop feedback winding. This should bring the detector smoothly into oscillation as it is advanced from the full open position. When in the full open position the set should not oscillate and the reception will be weak and very broad: as it is advanced the signal strength should improve and near-by stations should be rejected. Best results are obtained at a point just below oscillation. If it appears that the set is oscillating at all settings of the control, it may be necesasry to remove some turns from the reaction winding or increase the space between it and the tuned winding.

K.J. (Alphington, Vic.) suggests that we publish an article on loop aerials for crystal sets and some suggestions for uses for neon lamps. He is also interested in the "penny-in-the-slot" motion picture devices found in amusement parks and wants to know how they operate.

A We doubt very much whether there would be any point in discussing loop aerials for crystal sets, since these sets require the most efficient aerial it is possible to provide, plus an earth, if they are to give reasonable results. Loop aerials would seldom be efficient enough and are, therefore, unsuited for this type of set. Neon lamps can be used wherever a low consumption indicating lamp is required and have the advantage of not generating any appreciable heat. There are many specialised applications for these devices but it is usual in such cases to employ a tube which has been specially designed for the job rather than a standard type of indicator lamp. For this reason it is necessary to consider each application in relation to the associated equipment. If you have a particular application in mind and care to send us details we may be able to advise you further. The moving picture in the arcade machine operates on exactly the same principal as the ordinary cinema, the only variations being those of detail. The image is usually projected on to a ground-glass screen and viewed from the rear, the film in the projector being transposed left to right to allow for this. 16mm projectors are usually employed.

D.M. (Gladstone, Qld.) sends a query for the "Here's Your Answer, Tom" feature.

A. Our thanks, D.M. Your question will be dealt with at the earliest opportunity.

J.E.P. (Brisbane, Qld.) is anxious to make up an RF oscillator which can be adapted to produce signals showing when fencers score a touch.

A. We are not quite sure how it would be applied, J.E.P., but, in any case, one has to be very wary with equipment which generates and propagates an RF signal into space. The remark is as true of the so-called phono-oscillators you mention as of anything else. Such devices are only permitted by the authorities providing they do not use more than a very small specified amount of power input and providing they are incapable of producing interference in neighboring receivers. From your letter it is obvious that you have not had much experience wtih radio and are hardly in a position to carry out experiments along this line. The idea of using the "Porta-Player" and making it oscillate is way off the beam, your whole idea really involving a rather delicate developmental project. Interesting though it might be, we could not possibly undertake to help you with it. In view of all this, questions about the suitability of specific relays, &c., are of no significance. It might be much simpler and feasible to adapt a simple DC circuit to ring a bell on a touch. It may be possible to run light flexible leads to the objects involved, without hindering movement. It would seem that you would have some such problems, anyway, even with RF circuitry.

N.O.V. (Forbes, NSW) writes to say that he has found much pleasure in reading Radio and Hobbies since he became a reader in 1943. He makes two suggestions regarding future articles and also encloses a question for the "Here's Your Answer, Tom" feature.

A. Thanks indeed for your letter. Ten years is a reasonable trial! A double doublet aerial which would be very suitable for the reception of Australian short-wave stations was described in Radio and Hobbies some time ago. Mention of it was also made in the 1950 edition of the Australian Shortwave Handbook. In any case, a diagram of the aerial, together with a brief descriptive article, is available through the 2/- query service. We agree that many would be interested in an article on model electric motors, but the difficulty is to describe anything for which home constructors will be able to get parts.

The job of cutting laminations and making worthwhile commutators is a bit too difficult to do at home with relatively primitive tools. From a purely theoretical point of view, or with the idea that readers may wish to rewind burnt-out motors, an article on the subject may be useful. Your "Answer Tom" query will be kept in mind.

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Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

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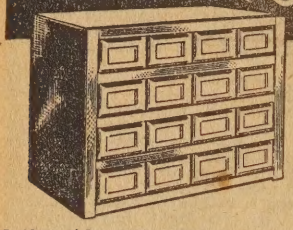

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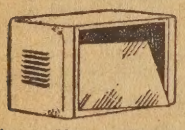

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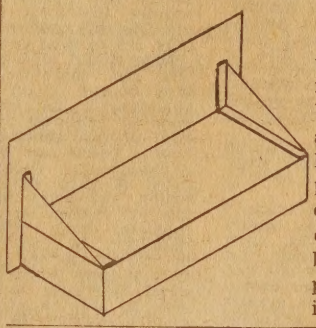

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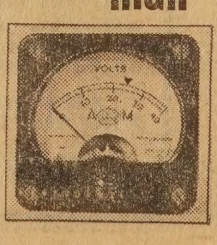

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EIGER COUNTERS FIND URANIUM

(Continued from Page 35)

units could be used. The fila- and one other element of a ture battery valve would also atisfactory in certain circuit gements.

form of high-voltage supply, is finding popularity in the ercial field, makes use of a ooth-shaped pulse which, when ified and fed to a suitable value ductance, produces a fairly high voltage pulse. This is rectified, ed and fed to the Geiger tube. e output voltage level can be olled by varying the voltage e of the electrodes of the amp- valve.

ere are various methods of ob- g the initial saw-tooth wave- One is a simple relaxation ator in which a suitable neon is connected across a capacitor from the high-tension battery gh a resistor.

N OSCILLATOR

the capacitor charges, the ge across the neon lamp rises the neon strikes and short- its the capacitor. As the volt- alls, the neon lamp extinguishes he cycle repeats itself ad lib. e value of the resistance and capacitance sets the frequency peration of the circuit, usually een 500 and 1000 cycles per d. Within certain limits, the ency is relatively unimportant.

e saw-tooth wave from across capacitor is fed to the grid of nplifier valve which has a suit- value of inductance in the e circuit. During each cycle, late current builds up until it uddenly cut off. The sharp ge in current through the in- r produces a momentarily high e of peak voltage across it which en passed to a suitable rectifier.

e high repetition rate of these s maintains a charge on a capa- at the rectifier output. The oped voltage is filtered and fed e Geiger tube.

other method is to use a pair lves in a multivibrator circuit. iode, or triode-connected pen- is used in one half of the cir- with the screen, grid and fila- of a pentode acting as a triode he other half. The output is from the free anode of one de fed from high-tension gh an inductor.

-GENERATING SUPPLY

high peak voltage is developed s the inductor and rectified as e previous method.

e flyback EHT arrangement in some television receiver de- has given a clue to yet another ble type of power supply for a r tube.

is supply is termed "self- rating" because the output from Geiger tube amplifier initiates charging cycle in a rectifier/ combination. The main re- ment is that the filter capacitor f suitable value and that the hencing pulse be provided by n/off switching.

may have more to say about design in the next article on er counter construction.

While the preparation of the Geiger tube for the production of pulses is a basic necessity, the remainder of the circuitry is governed largely by individual requirements.

It is actually possible to hear the pulses from the Geiger tube with a pair of headphones connected across the high value resistor in series with the supply to the Geiger tube. Ideally, the phones should be high impedance and good quality, preferably the crystal type.

Alternatively, high impedance magnetic headphones could be coupled through a transformer to limit the amount of shunting of the Geiger tube resistor. A miniature speaker transformer is handy for this job.

Using headphones in this fashion has its limitations, and to avoid the strain of mental concentration on the relatively low level in the phones, a high audio output is desirable. Except in certain special applications, a single stage is quite adequate. If a power valve is used there would be enough output to operate a small speaker.

It seems, however, that most prospectors prefer to use headphones rather than a speaker, because background noises and wind interfere less with comfortable listening to the pulse count.

SINGLE EARPHONE

A single earphone with headband could be worn, changing it from one ear to the other at odd intervals to avoid discomfort. A hearing aid earpiece may also be worth considering.

It is important to realise that the only function of the amplifier is to make the counts comfortably audible. If a count is recorded at a certain distance from a source of radio-activity, no amount of additional audio amplification will increase the distance at which the count will be registered.

The sensitivity of a Geiger tube is a function of its design and it is necessary to have only sufficient audio amplification to ensure clear audibility of the count pulse.

While audible indication of the count is desirable, in that it leaves the eyes free to guide the counter probe and to scrutinise rock formation, it is not the only method. A small neon tube flasher is often used as a supplementary visual aid.

Either of these methods would suffice to indicate presence of radio-activity, which, after all, is the first step in prospecting. They are not, however, suitable for estimating the amount of radio-activity.

Most uranium prospectors concern themselves solely with locating possible sources of active material and simply send samples to a Government office for determination of radio-activity.

The Geiger counter can be arranged to give some idea of degree of radio-activity by adding a count-rate meter. Each count pulse is fed

(Continued on Page 111)

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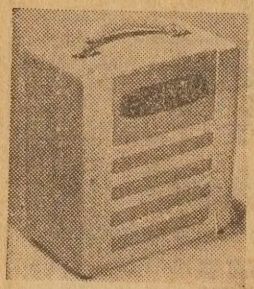

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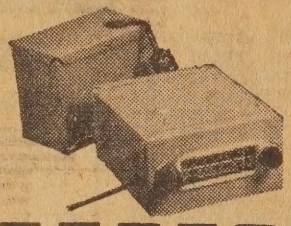

Illustrated: Top—Jubilee Portable. Bottom—Karset.

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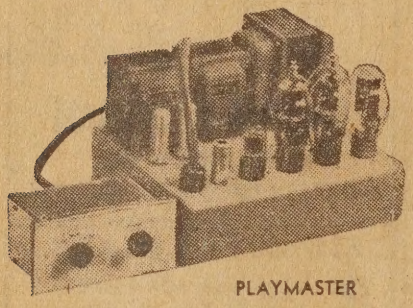

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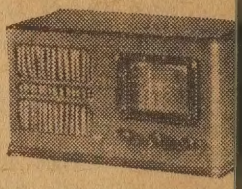

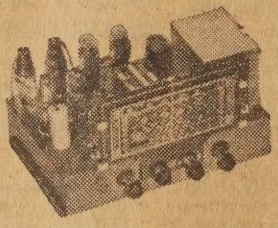

ing small and super-de radiograms, whilst countryman is catered with battery-operated, v tor-operated. and 32 receivers. There are n 100 sets featured in E Kit Set Catalogue. Illustrated:. Fireside. 5. Vibragram 7.

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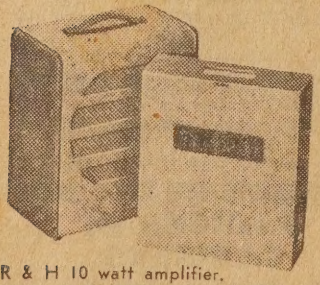

R & H 10 watt amplifier.

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